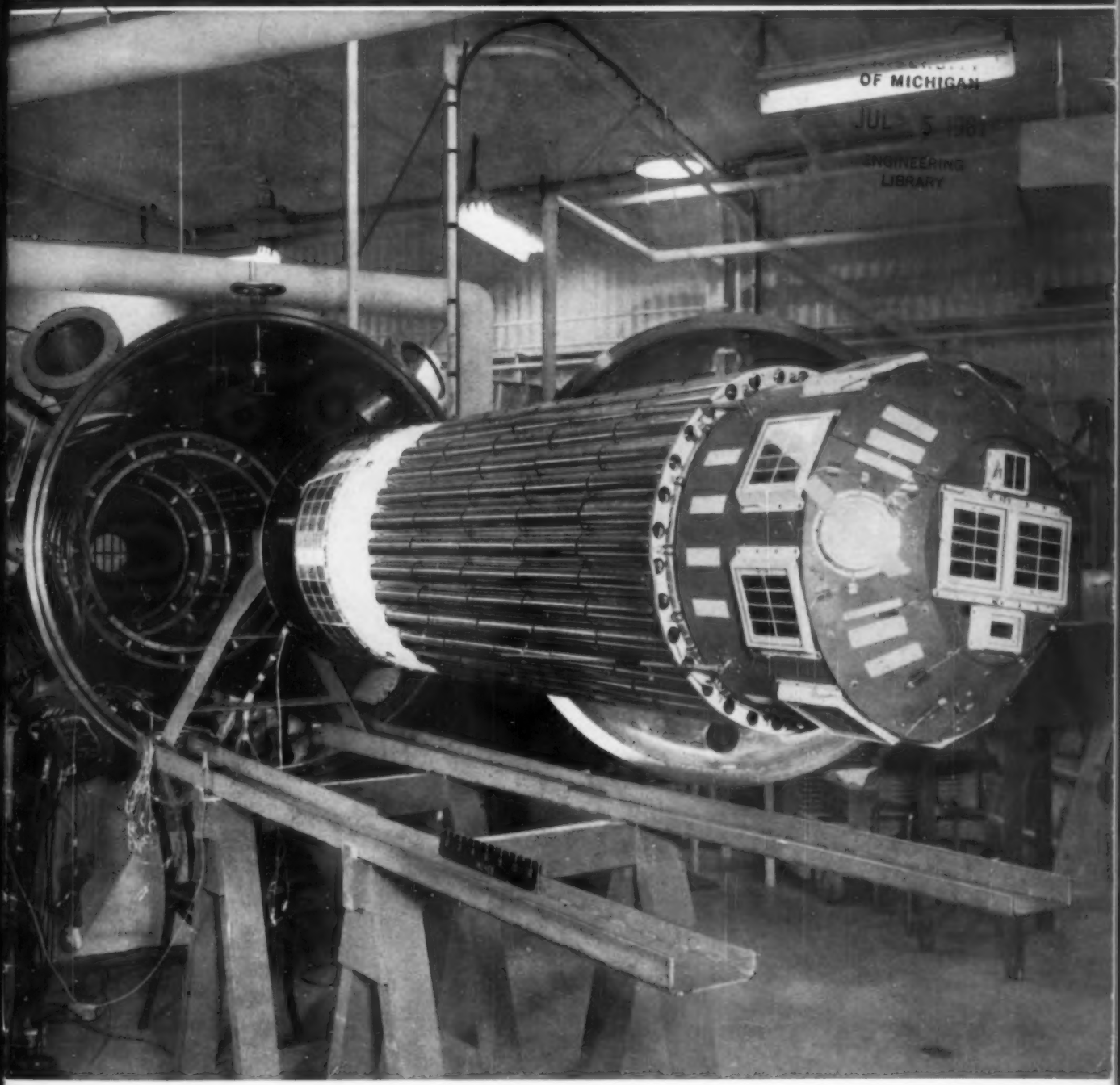
missiles and rockets

THE MISSILE/SPACE WEEKLY



S-55 Micrometeoroid Satellite Gets Vacuum Test

Congress Pushes Dyna-Soar Acceleration
Douglas Proposes Beefing Up of Thors . .
Latest Edition of M/R's Astrolog . . . . . .

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GESAC

New flight control system is fully self-adaptive, performance-proven in flight testing

A whole new flight spectrum of manned and unmanned vehicles is at hand. To meet the unique range of control requirements of these vehicles, General Electric now offers a completely new type of flight control system, called GESAC. (General Electric Self-Adaptive Control.)

A knowledge of the detailed aerodynamic characteristics of a missile or aircraft is not required to apply GESAC to the vehicle. Thus, both flight testing and application engineering effort can be sharply reduced.

No external air data sensors or computers are required for gain changing.

GESAC has already been successfully flight-tested aboard the Convair F-106 under Navy Bureau of Weapons sponsorship. An evaluation of extremely rigorous re-entry profiles has been conducted on the North American/NASA X-15 Simulator under Air Force contract, with outstanding success. A flight evaluation on the McDonnell F4H-1 is currently in progress under Navy BuWeps contract. GESAC provides another example of Light Military Electronics Department leadership in aero/space electronics.

150-03

GENERAL ELECTRIC

Light Military Electronics Department

Armament & Control Section, Johnson City, New York

Circle No. 1 on Subscriber Service Card

Is Defense Advertising Necessary?

There has been a lot of talk lately about the cost of the advertising done by defense contractors. One prominent Senator recently said he was greatly disturbed over heavy defense advertising expenditures. He pegged the cost "to the taxpayer" at $500 million.

This figure is many, many times the actual total of defense advertising expenditures and only a fraction of that total is recoverable. The Senator's facts are wrong; but, even more disturbing, it appears that he doesn't understand the purpose and function of sound advertising. He considers this money down the drain and thinks it should not have been spent.

There are other instances demonstrating a growing wave of anti-advertising sentiment in high government places. They indicate a lack of understanding and represent a threat both to freedom of the press and success of the Nation's defense goals.

We publish specialized business magazines and reference books. Several of these are defense oriented. They perform communications functions essential to our national goals . . . more essential now than ever before because of the complexity of today's technological and political challenges. There are other excellent magazines having the same or similar purposes. We're delighted—because competition is healthy and because there is more to be done than can be handled by any one of us.

Virtually all publications are financed, by and large, by advertising. This is healthy, too; but it is not the primary reason for defense advertising.

We believe that advertising is an effective and necessary tool for the defense contractor. The objectives of defense advertising are many: some of them obvious, others more subtle.

Sales is one obvious objective. It can be demonstrated that advertising, for some defense products, has led directly to sales. In other instances, selling is a long, complex process, where features of current products may not be as important as company reputation. In both cases, the government wants competition for defense contracts—by use of a competitive bidding system, it gets better products for less money. How is a company to compete if it is not allowed the use of sales tools—one of which is advertising?

Recruiting is another obvious objective. Will that engineer who is inspired to contribute to technological advancement in the missile/space age, for example, be interested in learning more about the kind of company he goes to work for? You bet he will, and more power to him.

The dissemination of technical information is a third, and perhaps the most important, objective. The exchange of such information is one of the biggest problems facing both government and industry. And what more effective, more economical means of disseminating necessary technical information exists than the business press? Mills Shepard, who performs readership studies on one of our publications, reports that advertisements are often read as avidly as the editorial pages. And Eastman Research, in a study released May 29, based on more than 100 surveys for 32 business-paper clients over a two-year period, reports that *70% of the readers interviewed read the advertising in these businesspapers on purpose.*

There are many other equally important objectives. Companies must raise capital in order to be able to do the jobs that need doing for defense. Good community and employee relations are considered necessary to a company's well-being. These and other objectives have been effectively achieved by defense contractors through advertising.

The defense industry is made up of numerous private companies facing the tremendous challenge of meeting, in cooperation with the government, our national technological goals. To meet this challenge, the companies must be strong and healthy. To deprive them of the use of effective and honest advertising is shortsighted and wrong.

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SHOWN ½ SIZE

KEARFOTT KING SERIES MINIATURE FLOATED RATE INTEGRATING GYROS

Combining the advantages of small size, exceptional reliability and unparalleled performance, the King Series, representing a major improvement in precision floated gyro design, is now in quantity production.

Day-to-day performance of 0.1°/hour without trimming over a 4 month period has been obtained. During these tests, the gyro was maintained at operating temperature only during tests and permitted to cool to room temperature between tests.

Simplified construction yields high reliability while unique design techniques have made possible highest angular moment of any gyro in comparable size.

Two basic gyros constitute the King Series, a gas bearing gyro motor offering long life and low noise characteristics, and a conventional ball bearing permanently lubricated gyro motor.

CHARACTERISTICS

	C70 2590-001 Gas Bearing Spin Motor	C70 2519 001 C70 2523 001 C70 2520 001 C70 2527 001 Ball Bearing Spin Motor
Angular Momentum (gm cm²/sec)	3.5×10^5	5×10^5
Drift, Vertical (short term) (°/hr.)	0.003	0.003
Drift, Azimuth (short term) (°/hr.)	0.015	0.015
Mass Unbalance (max. each axis) (°/hr.)	0.2	0.2
Fixed Torque (max.) (°/hr.)	0.2	0.2
Mass Unbalance Shift (max. spread) (°/hr.)	0.2	0.2
Fixed Torque Shift (max. spread) (°/hr.)	0.2	0.2
Torquing Rate (max.) (°/hr.)	22,000	22,000
Torquer Linarity (% to 165°/hr.)	0.01	0.01

FEATURES

C70 2590 001 — Provides high temperature capabilities and minimum operating life of 10,000 hours.

C70 2519 001 — Incorporates heaters and temperature sensors. It is trunnion mounted.

C70 2520 001 — Similar to the unit above, it incorporates switches that close when gyro comes in contact with its stops.

C70 2523 001 — identical to the C70 2519 001 except flange mounted at gyro CG rather than trunnion mounted.

C70 2527 001 — Basicly the C70 2519 001 in an IRIG mechanical configuration.

Write for complete data

KEARFOTT DIVISION
GENERAL PRECISION, INC.

Little Falls, New Jersey

letters

Stockholder Protests

To the Editor:

As an A.T.&T. Company employee and stockholder, I feel that your June 19 editorial ("Let's Temper Urgency with Caution") is biased in favor of the so-called "missile/space" firms, which is, of course, understandable. However, I would like to express my views . . .

First, I don't agree that the FCC's belief that the venture (space communications) be turned over to the international common carriers is a "decision in advance." To my way of thinking it is only logical that satellite communications be handled by those with the experience and proven capabilities of the communications industry, because satellite communications, to be of the greatest value to the public, must supplement and improve existing systems. Therefore it seems to me that the FCC is being more than fair when it considers objections to this logical step.

Secondly, as far as the anti-trust laws are concerned, I personally don't understand why those companies engaged in the production and sale of communication equipment should necessarily be involved in the ultimate use made of their equipment. If this held true for communications as we now know it, the telephone systems would be involved in such a muddled ownership mixup that our progress would be nowhere near its present high state. Take the case of the underseas cables. Should the shipbuilding industry be involved in the cable ownership just because a ship was used to lay it? And how about the cable manufacturer? Does he rate a slice of the ownership? I think not. Communication facilities are owned by those who provide communication services.

Third, your statement that technical merits of the various satellite systems proposed should be studied is ridiculous. The A.T.&T. Co. and its partners, both domestic and foreign, are prepared to finance a satellite communications system NOW. Developments are far along in the program to supply communication satellites and their ground equipment. A go-ahead is all that is needed and, most important—it won't cost the taxpayer a cent.

Fourth, the questions you say should be answered before a decision is reached have been answered—many times over—in recent months. The FCC is aware of them. President Kappel of the A.T.&T. Co. has made many public speeches setting forth his company's position on ownership, use, division of revenues . . .

In conclusion, I . . . quote from a recent speech by Mr. Kappel: ". . . the creation of the satellite system we propose in order to do our public service job as it ought to be done would not under any circumstances preclude the development of other space communication systems for other purposes. Space is a great big place and we don't expect to fill it."

Ralph E. Burns
Beachwood, N. J.

(Continued on page 49)

THE MISSILE / SPACE WEEKLY

missiles and rockets

Volume 9, Number 1 July 3, 1961

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THE COVER

NASA's S-55 micrometeoroid satellite emerges from vacuum chamber at Langley, during testing prior to scheduled launch last week on Scout 5. See p. 14.

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Facilities. Presently under construction on a 110-acre site at Redondo Beach, near Los Angeles International Airport, is the STL Space Technology Center comprising ten buildings specially designed for research and development in missile and space systems, for the fabrication and environmental test of subsystems and components, and for the production of scientific and technical devices derived from STL's sustained research program. These new facilities will be augmented by the STL research and fabrication installation at Canoga Park, California.

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BALLISTIC MISSILE PROGRAM MANAGEMENT (Los Angeles, Vandenberg AFB, Norton AFB—San Bernardino). Responsible for systems engineering and technical direction for the Air Force ICBM Weapon Systems Programs—Atlas, Titan, and Minuteman—including achievement of all technical objectives of these programs.

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ELECTROMAGNETIC SYSTEMS DIVISION (Canoga Park, California). The Radio Physics and Signal Equipment Laboratories of this division are engaged in developing advanced communication, radio direction finding, electro-optical, and penetration and reconnaissance systems; and in investigating advanced signal processing, electronic and anti-submarine warfare techniques.

FLIGHT TEST OPERATIONS (Cape Canaveral). Responsible for directing systems test programs and for supplying technical leadership to contractors conducting flight testing of ballistic missiles, space programs, and vehicles modified for special development purposes.

Resumes and Inquiries from engineers and scientists, at all levels of experience, will receive prompt and careful attention. All qualified applicants, regardless of race, creed, color or national origin, are invited to communicate with Dr. R. C. Potter, Manager of Professional Placement and Development, for opportunities in Southern California or at Cape Canaveral.

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Those attending Wescon are invited to visit STL at booth #209

The Countdown

WASHINGTON

Maxwell Taylor—Single 'Chief'?

There's mixed reaction inside and outside the Pentagon to President Kennedy's recall of Gen. Maxwell Taylor as his personal military representative. The question is being raised whether Taylor will become—in reality—a single "chief of staff" interposed between the President and the Joint Chiefs. Taylor's advice, in any event, is expected to weigh heavily in any military decisions involving the Berlin crisis—and he has held the view that if war came Russia could be stopped on the ground in Europe.

Nuclear Handwringing Ends

Much governmental handwringing—in evidence for a year or more—has ended with the decision to finally fly a small *SNAP* unit. A nuclear auxiliary power source was scheduled to go aboard a June 28 satellite package containing *Transit IV-A* just days before the flight. Even though units have been ready to go for more than a year, the government has held off in fear of international reaction.

Next Mercury Redstone Shot

Second *Mercury Redstone* carrying an astronaut on a ballistic flight path down the AMR is now set for some time in July 20-31 period. Changes in the capsule include a larger observation window, improved manual controls for "piloting" spacecraft in orientation phase, and a new escape hatch.

Doubts on Dyna-Soar

Some Pentagon planners are siding with Defense Secretary McNamara in doubting whether it is possible to speed up the *Dyna-Soar* program (see p. 10). They are challenging, moreover, whether a space-bomber ever will be feasible or desirable because of the restrictions imposed by orbital flight. Look for a major behind-the-scenes fight on the release of extra *Dyna-Soar* money voted by Congress.

Super Polaris Contract Due

COUNTDOWN hears award of the second-stage motor contract for the 2400-mile *Polaris A-3* is imminent. Chief contenders for the big program are Aerojet-General and Hercules Powder.

INDUSTRY

A-G Firing Bigger Solid Segments

Pursuing its big segmented solid-booster program, Aerojet-General expects to fire a 500,000-lb.-thrust motor in August and follow it up with a 1-1.2-million-lb.-thrust engine in November. Latter motor will have three segments and fore and aft sections, firing time of 65 secs., specific impulse of about 245.

NSIA Pushes Cost-Cutting

National Security Industrial Association is setting up 10 study groups to attack rising defense costs. The studies are probing into the problems of development leadtime, reducing engineering change-orders. One group looking into the over-abundance of specs in contracts already has submitted a report to DOD.

R&D Intelligence

Norair Division of Northrop has a $79,000 Air Force contract to study self-sealants for spacecraft. It will use its 8000 ft./sec. micrometeorite gun for tests. . . . Rocketdyne sees its J-2 engine coming in on or ahead of schedule in early 1963. . . . Rocketdyne also reports the F-1 engine has produced thrust of 1 million lbs. or more in 136 tests. . . . Navy's new VLF station (well over 1 million watts) at Cutler, Maine, may be tied into a military communications satellite network when it's ready.

Astronomical Error

JPL's Eberhardt Rechtin says the Russians are wrong in their astronomical unit of 92,812,797—perhaps because the Soviets used some old U.S. figures last April. The JPL astronomical unit is 92,956,000, and Rechtin maintains this is correct.

ComSat Battle (cont.)

General Electric considers it won a major victory with the Kennedy decision to put the commercial communications satellite issue up to the Space Council for resolution. This will delay an expected FCC decision in favor of A.T.&T. But GE's worry now is that the government itself may decide to take over the project.

INTERNATIONAL

Nord Sells AS-30

COUNTDOWN is told that at least one country—West Germany, Britain or France—has decided to buy Nord's air-to-surface *AS-30*. The bird is being offered to NATO countries as a competitor to the Martin *Bullpup*.

Space Interest Grows

The U.S. expects West Germany and Japan to join the growing list of nations cooperating in space projects. No agreements have been signed yet. Both countries are interested in weather and communications satellites.

Overseas Pipeline

West Germans, still haggling over conditions, are holding up announcement of the formation of the European space booster organization. . . . Short Brothers have opened a technical liaison office in Sydney, to handle its *Seacat* business with Australia and New Zealand. . . . Construction is underway at Goonhilly Downs, in Cornwall, for a British ground station to be used in U.S. communications satellite tests next year.

There's Always Some Character Who Doesn't Get The Word!

Why?

COMMUNICATIONS

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"Better Liaison Between Industry and Government"

The Missile/Space Week

Alternative for Zeus

ARPA has picked a four-company team headed by Raytheon to devise an anti-missile method other than the Army's *Nike-Zeus*.

The program, called ARPAT (Advanced Research Projects Agency Terminal), will attempt to find a way to destroy ICBM's without the use of a nuclear warhead, as they near the end of their flights.

The two-and-one-half-year study, involving about $15 million, breaks down this way: $7 million for radar development by Lincoln Laboratories and Raytheon; $7 million, Hughes Aircraft for interceptor vehicles; $1 million for system planning split among Raytheon (30%), Boeing Co. (30%), Hughes (30%) and IBM (10%). Boeing will concentrate on lofter and supporting base facilities.

Shots of the Week:

First attempt at flight-testing the *Titan II* all-inertial guidance system (M/R, June 19, p. 18), as a passenger on a *Titan I* missile, was thwarted when the missile malfunctioned and fell short of its range.

It was launched from Cape Canaveral June 23.

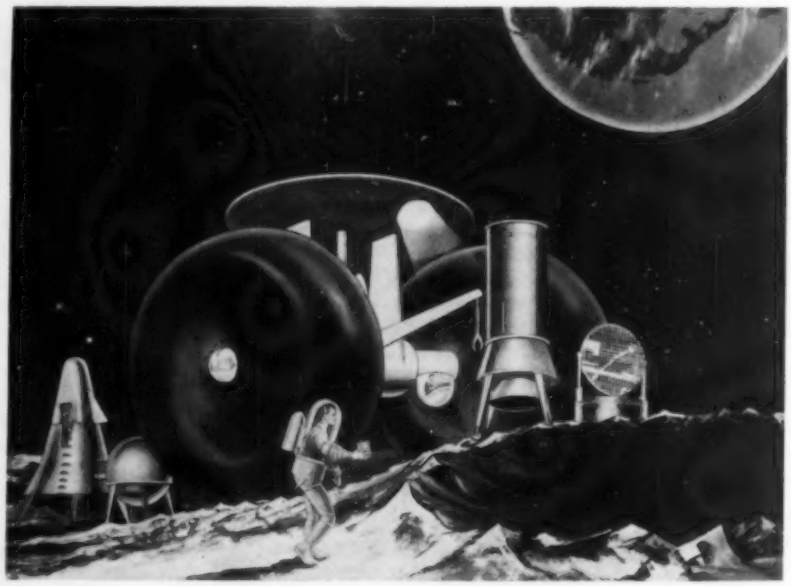
Air Force plans to have the *Atlas E* operational this year were set back when the sixth missile in nine test firings at Cape Canaveral exploded after 95 seconds of flight. The mishap occurred June 23.

The Army scored a complete success with the final firing June 26 of a *Redstone* missile, in an engineering qualification program of production missiles.

At Eglin AFB June 23, the Air Force successfully fired a *Nike-Cajun* research rocket for micrometeoroid study (see p. 40).

Also on June 23, Major Robert White again sped the *X-15* to a new speed record: 3690 mph, only 310 mph short of its intended maximum.

The Navy shot but missed with its advanced-model *Polaris* June 27. Fired from the USS Observation Island, the missile was launched uneventfully, but missed its target by "scores of miles."



RCA Moon Camp Conception

REMOTELY BUILT: Base camp on moon which would be placed and stocked by series of Saturn shots is envisioned by Radio Corp. of America artists. RCA proposes constructing a remotely controlled roving vehicle to survey lunar surface to find most appropriate area for manned landing. Entire operation would be checked out by ground instrumentation before man ever set foot on moon.

Anderson to Succeed Burke

Vice Adm. George W. Anderson, now commander of the Sixth Fleet, has been chosen next Chief of Naval Operations over about 10 admirals with more seniority or rank.

Adm. Arleigh A. Burke retires after three terms August 1.

Testing Mercury Tracking

NASA will test its recently completed world-wide *Mercury* tracking network late this summer.

The plan calls for orbiting a 100-lb. satellite containing transmission and receiving equipment which will be identical to the equipment in the *Mercury* spacecraft.

The satellite will provide real-time calibration, training and operation experience for the new 16-station *Mercury* tracking network as well as orbital flight test of *Mercury* communication gear.

It will be launched into a 300-mile orbit by a *Scout* booster. Satellite package and booster will be prepared for flight by Aeroneutronics Systems Inc.

Working and communications equipment will be provided by McDonnell Aircraft Corp.

The satellite—to be called *Mercury Scout I*—will be launched from Cape Canaveral.

NASA Reactor Goes Critical

Lewis Research Center's Plum Brook reactor at Sandusky, Ohio, a nuclear test bed for spacecraft power units, began operating June 14.

Study of radiation effects on components and materials for nuclear power systems will be its primary function. It will simulate radiation environments of such power plants as *SNAP* and *Rover*. Pumps, turbines, shielding, propellant feed systems, other components and materials will be tested.

The reactor will be run at low power for a short time to check operation and calibrate instruments, then shut down for a month-long AEC inspection. After inspection, the reactor will slowly be brought up to full power level of 60 megawatts.

Strictly Academic

Latest move in the Soviet research shakeup: the Academy of Sciences has been stripped of at least 30 of its institutes.

Observers say the move reduces the Academy's role to pure science. The institutes, all concerned with problems of application, have been transferred to other government departments. About 2000-3000 employees are affected. The Academy apparently will merely provide one part in the Soviet research machinery, which now puts major emphasis on technology.

President of the Academy is Mstislav V. Keldysh, a mathematician known for some time for his theoretical studies in areas of mathematics such as calculus of variations.

NASA-Argentine Project

NASA announced an agreement with Argentina on a cooperative space program using sounding rockets.

A memorandum of understanding was signed by NASA and the Argentine National Commission on Space Research.

The Argentine agency, as part of its space science research program, plans to conduct studies in the fields of meteorology, ionospheric physics and cosmic-ray detection utilizing rocket soundings.

NASA will provide, among other things, training facilities for certain Argentine scientists. It will also transfer small unnamed sounding rockets to be used in the launchings.

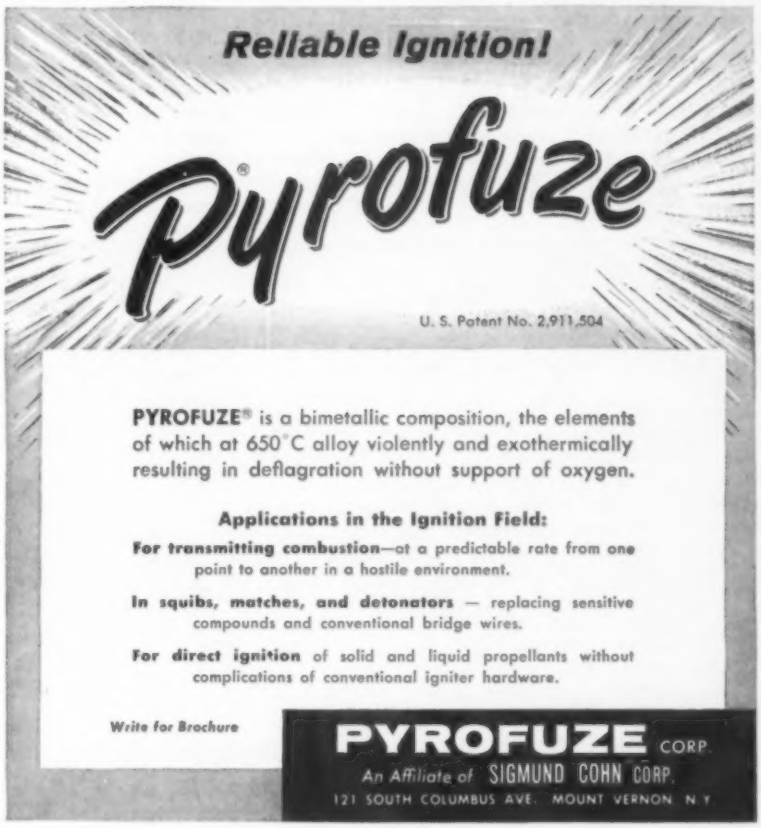
Any (Space) Bonds Today?

The Treasury Department has received a proposal that it issue "Savings Bonds for Space" to boost the U.S. space drive.

Proposed by the National Rocket Club, the bonds would be designated "Series S." The club has designed a special stamp bearing Astronaut Alan B. Shepard's likeness.

Although the Office of the Secretary of the Treasury has pointed out that funds raised by the bonds could not be earmarked specifically for the space drive, proponents of the plan say it would encourage scientists and astronauts—as well as provide an extra source of revenue.

A similar proposal was made recently by Sen. Kenneth B. Keating (R-N.Y.).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House OK's DOD Funds . . .

Dyna-Soar Streamlining Urged

by William E. Howard

CONGRESS is attempting to prod the Kennedy Administration into a 3-year speed-up of *Dyna-Soar* to guarantee a manned orbital flight of the space glider in 1964.

But a move to implement "Project Streamline" by earmarking an additional $85 million above the $106 million in the FY '62 budget for *Dyna-Soar* met little enthusiasm at the top of the Pentagon.

Said Defense Secretary McNamara: "I doubt very much that we can expend that effectively and efficiently but I certainly wish to re-examine the problem."

The beef-up in *Dyna-Soar* funding was one of the main new features of the $42.7-billion FY '62 military appropriations bill as it passed the House last week—a $2.4-billion increase over FY '61. The House also disagreed with McNamara's assessment of the need for manned bombers and provided $448 million in new obligational authority for long-range bombers.

The bill, which was expected to receive speedy Senate approval, contained $231 million less than was asked by President Kennedy in his $1.9-billion add-on to the Eisenhower budget. But $225 million of the reduction was considered "technical," since the same amount will be transferred from unused prior-year funds in the Air Force's procurement account.

Going along with the House Appropriations Committee's sharp disapproval of military procurement techniques, the House voted a 2% across-the-board cut in all procurement accounts amounting to $308 million. The cut last year was 3%.

How the House broke down major funding:

ARMY

Appropriation — $10,359,000,000, $38.7 million over the budget request.

Procurement of missiles and equipment—$1,991,400,000, down $20.6 million.

RDT&E—$1,202,700,000, down $2.7 million.

O&M—$3.3 billion, up $8 million.

NAVY

Appropriation—$13,458,000,000, a $110,598,000 reduction.

Procurement of aircraft and missiles—$2,148,000,000, a $43.8-million decrease.

RDT&E—$1.3 billion, reduced by $5 million.

O&M—$2.7 billion, down $25 million.

AIR FORCE

Appropriation—$17,583,000,000, a $143-million reduction.

Missile procurement—$2,736,000,000, a $55.8-million decrease reflected in the 2% cut.

Aircraft procurement—$2.9 billion, a $72-million reduction.

Airlift modernization—$320 million, a $22-million increase.

RDT&E—$2 billion, up $60 million.

O&M—$4.3 billion, down $77 million.

The Appropriations Committee charged into DOD on *Dyna-Soar*—declaring that program planning "to date has lacked boldness and imagination." Apparently picking up a Boeing Co. plan approved and advanced by Gen. Bernard Schriever, the committee said "Project Streamline" could accelerate manned orbital flight by three years. Total cost of the program, moreover, could be reduced by about $300 million by the speed-up. It said the acceleration could be accomplished by:

—Using the *Saturn* booster to put the glider in orbit.

—In early flights, substituting available subsystems developed in other programs for more complex subsystems being developed for use in *Dyna-Soar*.

The committee made it clear why the speed-up was necessary.

"The potential military applications of the program are important. For the remainder of this decade the space area close to the earth's surface will be of greater interest to military planners than will the area around the moon."

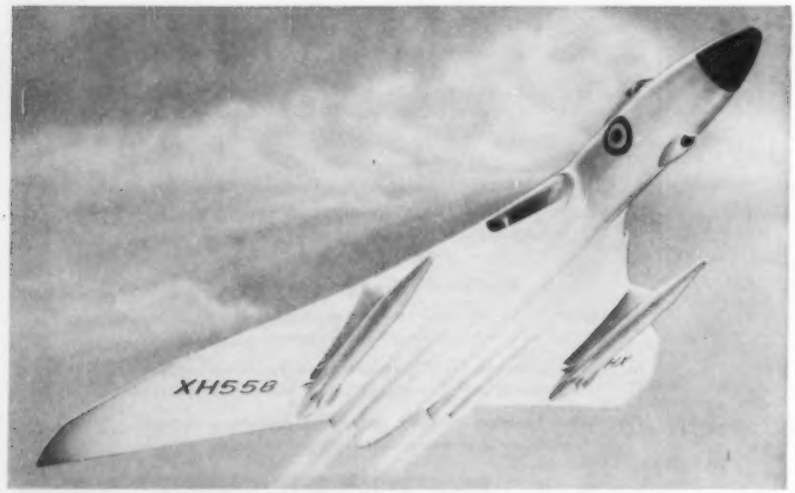
In attacking the program, congressmen contended that *Dyna-Soar* was being pursued at less than optimum pace. The Air Force had let it be known that it expected to start orbital flights in 1964-65. But apparently this was not really the case.

Defense officials queried by M/R this week maintained that there had been no change in the original timetable for the program since it was initiated more than a year ago. This timetable calls for an orbital flight in April, 1967 aboard a *Titan C* (which apparently never has left the drawing boards).

The speed-up, which the committee claims is feasible, would advance the date to early 1964, possibly late 1963. However, *Saturn* becomes a controlling leadtime factor; there are no officials connected with this booster program who say it will become "man-rated" before 1964 or 1965.

There apparently are some grave differences of opinion on the value of *Dyna-Soar* as a weapon, even if it is feasible. Although no one has attacked it publicly, some DOD officials point out that it has certain drawbacks as a bomber because it is tied to an orbit,

(Continued on page 42)



Vulcan Bomber with Skybolts

BRITISH VULCAN Mk II bomber is at Edwards AFB for compatibility tests with Douglas Skybolt. Aerojet-General has already fired flight-weight motors for the missile.

A.T.&T.'s PROPOSED satellite system.

For phone satellites . . .

Council Favors Private Ownership

by Hal Taylor

THE NATIONAL Aeronautical and Space Council—President Kennedy's space advisory group—leans heavily in favor of allowing private enterprise to own and operate a commercial communications satellite system.

Dr. Edward D. Welsh, executive secretary of the group, said—in referring to industry fears that the Kennedy Administration may decide to set up a government-owned system—that "there is no basis for that view."

Dr. Welsh's declaration was the latest development in an already muddled situation surrounding the question of who should own and operate communications satellites.

It followed President Kennedy's order to the council early last week calling for a study to determine how the system can be brought into operation "at the earliest possible time."

The policy proposals, the President said, should include recommendations on "the nature and diversity of ownership and operation" of a satellite system.

The President's action came shortly after the Justice Department informed the Federal Communications Commission that its tentative decision to award ownership of a commercially-operated system to certain international communications carriers "might violate antitrust laws."

The Justice Department stated its position as several space industry firms, led by General Electric, petitioned the FCC for the right to share in the ownership.

• **Reassurance**—While officials of missile/space industry companies involved welcomed the President's action —which in effect will delay and influence a final FCC decision—they indicated that they are worried by the sense of "urgency" conveyed in the President's order.

They fear that the Administration, in its haste to beat the Russians in setting up a space communications system, will turn to a government-owned and -operated system based on NASA's Project *Relay* program presently in the development stage.

Dr. Welsh, however, threw cold water on the whole idea. He said that the Council has already held several meetings with representatives of interested federal agencies and that "vast majority of opinion is that the system should be owned by private enterprise."

He said, however, that the commercial firms involved in the controversy have "over-simplified the whole project," and this is reflected in their belief as to how fast they could get it working.

The Administration official noted that many tests have to be made, an apparent indication that NASA will continue to have a large development role in the project.

It is also possible that the Administration policy will call for more government-industry cooperation in the project. This was hinted at by President Kennedy, who told the Council that any satellite system should be global in nature and capable of serving all the continents and underdeveloped nations.

"I am anxious that this new technology be applied to serve the rapidly expanding communications needs of this and other nations on a global basis, giving particular attention to those of this hemisphere and newly developing nations throughout the world," he said.

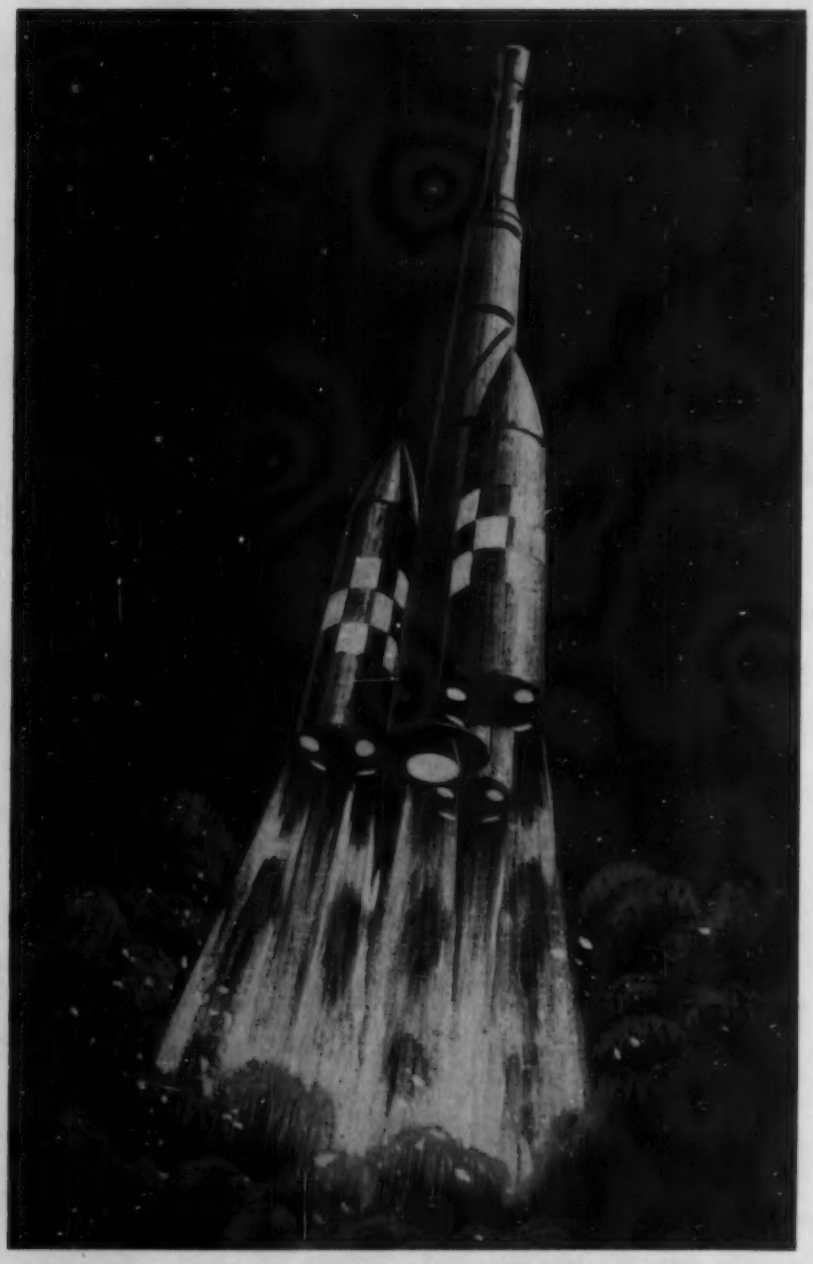
Since many of the underdeveloped nations do not have the funds necessary to build the ground stations needed to take part in the system, it is thought likely that the government may wish to provide such funds through foreign aid programs.

(Continued on page 40)

In three styles . . .

Douglas Proposes Beefing-up of Its T

'Thorad' family would double present payload capacity with relatively easy modification, fill gap between Thor and Atlas



M/R ARTIST'S CONCEPTION of blastoff of Thorad Jr., with Little Joes attached.

SANTA MONICA, CALIF.—An advanced version of the *Thor* space booster is being proposed by Douglas Aircraft Co. to double the present vehicles' payload capacity.

Designated *Thorad*, the new booster requires no major modification in the basic *Thor* vehicle, the company says, and hence could be flight-tested within one year after initiation of development.

The advanced booster comes in three designs—*Thorad, Thorad Jr.* and *Thorad B*.

—*Thorad* would have a constant-diameter airframe, instead of the present tapered frame of *Thor*. This would permit the addition of 35,000 gals. of propellant for longer burning. There would be no change in the 165,000-lb.-thrust Rocketdyne engine.

—*Thorad Jr.* would be the basic 165,000-lb.-thrust *Thor* space booster, with unaltered tanks but with three Thiokol solid-propellant *Little Joe* rockets fastened to its sides to boost total takeoff thrust to 315,000 lbs.

—*Thorad B* would be the greatest departure from the present *Thor*, having a Rocketdyne H-1 engine with 190,000 lbs. of thrust, a constant tank diameter of eight feet and three *Little Joes* for additional thrust.

W. H. Hooper, Chief Project Engineer, Thor Space Vehicles, said the company has studied vehicles using solid rockets larger than *Little Joe*. But he declined to say how much larger the rockets would be, or what conclusions the studies have reached.

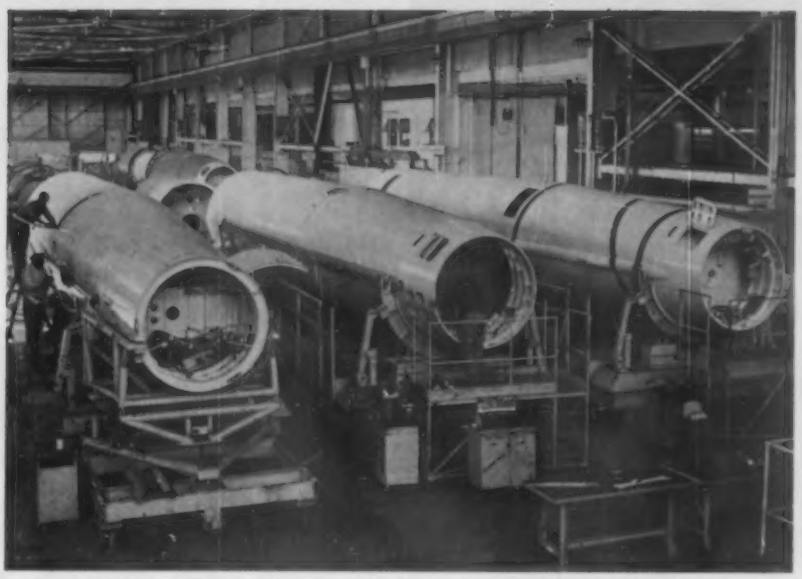
Douglas also declined to say what Air Force or NASA interests are involved in the proposals.

• **Easy changes**—Basic to the concept of advanced *Thor* vehicles is the fact that no major re-working of existing designs or hardware would be required. Modifications likely to cause stability, structural or other problems are avoided in the Douglas plans; nor would launch facilities need major revision.

With the 54,500-lb.-thrust *Little Joe* rockets attached, *Thor* would achieve 315,000 lbs. takeoff thrust, lasting for

Thor Booster

by Frank G. McGuire



TRIO OF THOR VEHICLES on assembly line at Douglas-Santa Monica. Left to right are boosters for Thor-Delta, Transit and Discoverer programs. Note the varying transition sections, with second-stage-exhaust venting ports and internal differences. Aft of the transition section, however, Douglas is now making all Thor vehicles identical.

about 28 seconds before the solid rockets would burn out and, shortly afterwards, be jettisoned. A single attach point would hold each of the three solid rockets to the side of *Thor*, with a lower strut used to add stability and prevent turning of the *Little Joe*.

Explosive bolts, actuated electrically from the ground, would free the solid rockets, which would be peeled away by aerodynamic forces much as in the British *Bloodhound* missile design. Range safety considerations would be a major factor in determining when the explosive bolts were triggered.

Canted nozzles on the *Little Joe* units would direct the thrust component through the center of the *Thor* by way of the upper attaching strut. Thrust vector control for the vehicle would be maintained by the main engine which would be gimballed.

Gross weight added to the *Thor* by the modifications would be about 25,000 lbs.; each solid rocket would contribute roughly 8000 lbs. of this, and miscellaneous hardware the remainder.

No vibration problems are anticipated with the modified design, although the overall acoustical level would rise.

The solid rockets would be ignited internally and automatically by the standard *Thor* equipment, and the ignition would always be accomplished before liftoff.

Beefing-up steps desirable for increasing *Thor's* performance can be accomplished in the field, the company says.

• **No ignition fears**—The question of mission completion should one or more solid rocket boosters fail to ignite is apparently causing Douglas little concern. Hooper points out that solid-rocket reliability is very high, and if an electrical circuit failure should cause problems with one of the solid rockets, the mission could still be carried out.

A degraded mission could be accomplished if none of the solid boosters ignited, and these would be dropped as soon as possible in order to minimize drag. With one unignited solid rocket in the system, *Thor's* gimballed main engine could compensate for the unequal drag caused by the dead rocket's presence until ejection of all solid units is accomplished.

Internal modification of the *Thorad* and *Thorad B* due to tankage expansion (*Thorad Jr.* involves no internal airframe changes in the basic *Thor*) would be slight—principally eliminating taper in forward sections and shifting the central bulkhead a bit forward to allow proportional changes in the capacity of each tank. Total increase in propellants by this move would be 35,000 lbs.

The boattail section and thrust beams would also have to be beefed up in the *Thorad B* version, to take the added push of the H-1 engine.

Altitude of the *Little Joe* ejection would be controlled by range safety, the flight trajectory followed and the weight of upper stages employed.

Douglas says it first tried attaching the *Little Joe* boosters flush against the *Thor* boattail section, but found that ejection problems were unjustifiably severe. Mounting on extended struts alleviated the problem and allowed aerodynamic forces to do the job. Although the design is still somewhat flexible, the space between the solid rockets and the *Thor* is expected eventually to be about a foot or less.

• **Stock items?**—If a customer is found for the *Thorad* proposal, Douglas expects to buy *Little Joe* units directly from Thiokol Chemical Corp. as a stock item.

Douglas feels that the entire vehicle would find a place, in terms of capability, between the present *Thor* space boosters and the *Atlas*-based space boosters. The company points out that a majority of U.S. satellites have been put into orbit by *Thor* vehicles, and that advantage should be taken of the booster's reliability record.

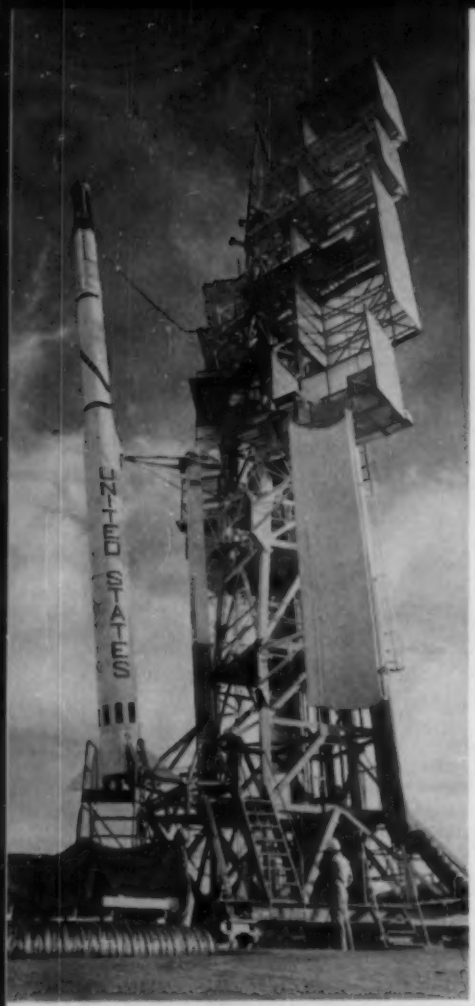
• **Present Thor**—Current *Discoverer*-series models of the *Thor* itself, thanks to numerous changes in design, have a payload capability 7000 lbs. greater than that of the initial tactical configuration. The 7000-lb. figure includes everything above the nose transition section of *Thor*, and assumes a low-orbit mission. Douglas has changed the vehicle designation from its original DM-18 to DM-21 (Douglas Missile 21) as a result of the product improvement program.

Part of the modification includes shortening of the upper transition section by 5½ ft.—a move which cut 400 lbs. from the airframe weight, and was made possible by eliminating the all-inertial guidance system and relocating the battery and inverter of the flight controller used on space models.

Other changes introduced by Douglas include substitution of lightweight aluminum for fiberglass tunnels carrying circuitry from the guidance to engine compartments; strengthening of engine compartments to accommodate the Block II Rocketdyne engines; and strengthening of the tank section bulkhead for the same reason.

The company estimates that more than 400 changes have been made to date. Although the exterior appearance

(Continued on page 42)



As secondary mission...

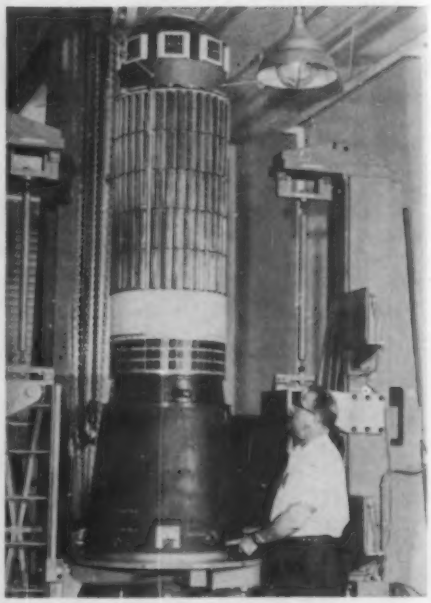
S-55 Hitchhikes on Scout 5 Solid Booster

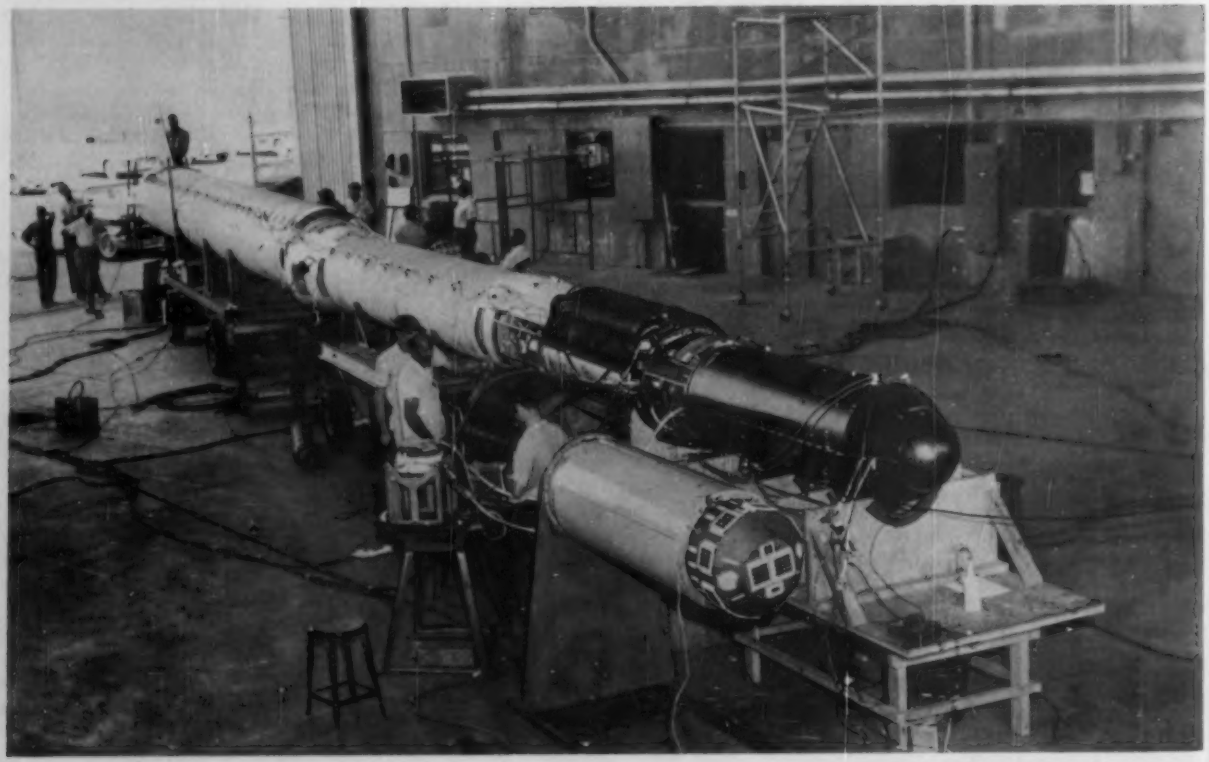
NASA's Scout No. 5—scheduled for launch last week at Wallops Island—was a double-barreled effort primarily to test the four-stage solid rocket. Putting the hitchhiking *S-55* Micrometeoroid Satellite (M/R, June 12) into orbit was only a secondary mission.

LEFT: *Micrometeoroid satellite (S-55) sits atop Scout 5 as only U.S. solid-fuel satellite booster is readied for launch at Wallops Island.*

RIGHT: *Scout's fourth-stage motor serves as carrier for hitchhiking micrometeoroid experiments.*

BELOW: *Complete Scout with payload is checked out at Langley prior to assembly at launch pad.*





Rubel Blasts DOD 'Tailfinism'

DOD'S JOHN RUBEL has taken a hard look at the Pentagon's weapon planners and finds them guilty of "tailfinism."

There's a strong tendency, says Rubel, toward "overstated requirements and degrees of automation or miniaturization considerably beyond the point of diminishing returns in operational effectiveness."

In a speech at the Fifth National Convention on Military Electronics in Washington, the deputy director of Research and Engineering let fly several other roundhouse swings at his own department.

He accused DOD of coddling poor advanced weapons system planning, of condoning duplication among individual agencies, and of allowing some projects to proceed in a "vacuum" so that obsolescence was built-in.

To reverse this sorry situation, Rubel said:

—DOD's advanced planning must assume a "more forward-looking and better integrated character"—specifically in unifying R&D planning and in managing R&D "from basic research on through hardware procurement."

—The team effort between DOD and industry must be "redeveloped" to insure that only those items that are needed—and attainable—are undertaken.

—Everybody must always be aware of the "abiding requirement for high-grade engineering effort in the most lowly parts of every system."

—"Finally, we must wage an unrelenting fight against the tendency for lead times to stretch out in any of the many ways this can happen, and project our development goals so that our deployed systems can enjoy a reasonably long and useful life."

More than 3000 MIL-E-CON participants, representing scientists, engineers and business executives directly concerned with the military electronics field, attended the three-day session, sponsored by the Professional Group on Military Electronics of the Institute of Radio Engineers.

Rear Admiral Frank Virden, director of Naval Communications, was the keynoter, calling for "good citizenship in the frequency spectrum." If this is not achieved, the admiral warned, "the building of the tower of Babel will be enacted all over again in this nation to our complete confusion and possible electronic strangulation."

He also stressed that developments in Command and Control systems must emphasize integration, survivability, sureness and flexibility.

The 1961 M. Barry Carlton Award for the best paper published in the *IRE Transactions on Military Electronics* was presented to William B. Glendinning, Army Signal Research and Development Laboratory, Fort Monmouth, N.J., by Dr. Witting, chairman of PGMIL, at a special awards luncheon. Glendinning's paper, published in the October, 1960, *Tranactions*, was entitled "Silicon Integrated Circuits." ⌗

Alaska BMEWS Station Operational

THE SECOND Ballistic Missile Early Warning System (BMEWS), at Clear, Alaska, went operational this week.

First of these giant 3000-mile-range Air Force radar systems—at Thule, Greenland—has been in operational status since October, 1960.

The third segment of the mammoth radar fan will be completed next year at the Fylingdales Moor site in Yorkshire, England.

Prime contractor for the almost $1-billion program is Radio Corporation of America.

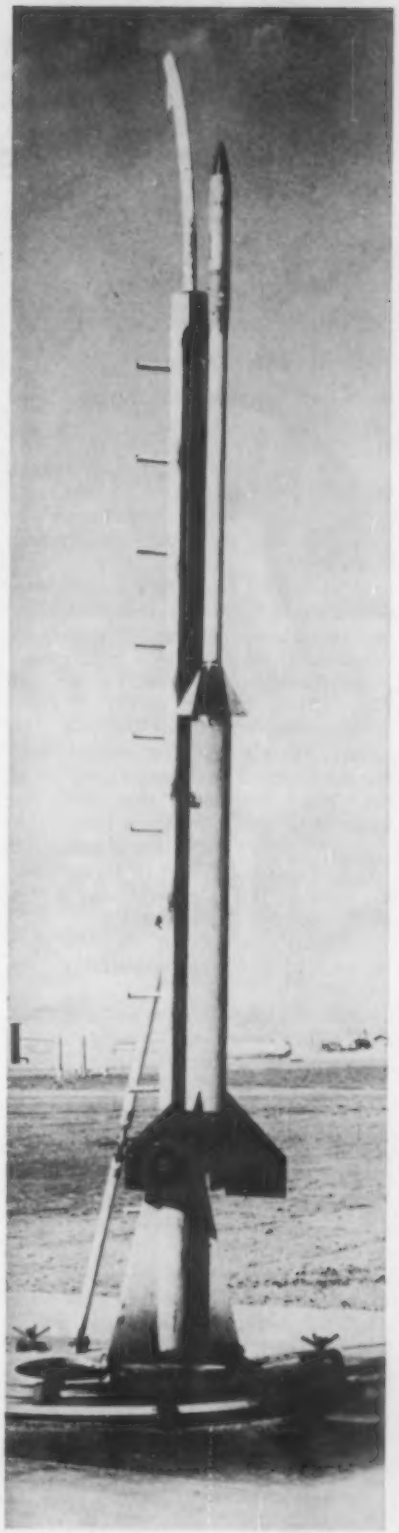
The Clear BMEWS station is almost identical to its predecessor in Thule, employing three gigantic torus-shaped search radars (165 ft. h. x 400 ft. lg.). Eventually, two 85-ft.-high tracking dishes will be installed at each of the sites. Tracking radars, being built by Goodyear Aircraft Corp., have been under test and evaluation for over a year now, but Department of Defense budget limitations have delayed production. Three of the trackers, however, will be installed in England, since the General Electric surveillance radars are not scheduled for installation there.

• **Switch in supports**—Only significant change in its surveillance radar screens, according to G.E.'s Heavy Military Electronics Dept. is the use of 70-ft.-long steel latticework backstays. Twenty of these support each reflector, replacing the tubular steel structural members employed at Thule. The latticework supports were necessary, said a department spokesman, to withstand the heavy earthquake tremors and 110-mile/hr. winds which could be experienced in Alaska. Each of the antennas weighs 900 tons, he said.

The reflectors were built for G.E. by D. S. Kennedy & Co., Cohassett, Mass.

Cost of the Clear station is expected to reach about $330 million—about $170 million less than the Thule complex.

(For hardware, subcontractor, and system details refer to M/R, May 23, 1960, pp. 36-40.) ⌗



Kisha-Judi Rocket

FIRST PHOTOS of Rocket Power Inc.'s new Kisha-Judi sounding rocket. The two-stage vehicle weighs 221 lbs. and can reach maximum altitude of 480,000 ft. with top 2nd-stage velocity of 3271 ft./sec.

Aerojet Bets on Space-General Corp.

Parent firm ready to invest several million dollars in subsidiary established with view to major contracts

AEROJET-GENERAL is making a major bid to expand its missile and space systems business by setting up a wholly-owned subsidiary—Space-General Corp.

The move, maintains Aerojet President Dan A. Kimball, is independent of any corporate jockeying for position in the competition to build a multi-mega-pound-thrust solid booster for the Air Force (M/R, June 26, p. 14).

However, officials of the new subsidiary concede that they will be seeking contracts for such major projects as the *Saturn S-II* stage that could be undertaken "either by Space-General or Aerojet." Space-General will not have any propulsion facilities of its own for the present. But this eventuality is not being ruled out. Says Kimball:

"Other elements of Aerojet may be merged into Space-General in the future."

Kimball told MISSILES AND ROCKETS that no major company realignment is contemplated in the competition for the contract to develop the big solid booster, which is expected to run to $500 million for motor R&D alone in the next three years.

"We have the capacity—plenty of it," he said. "In fact our mixing plant at Sacramento is running at only 40% of capacity right now."

But the former Navy secretary said that Aerojet already is anticipating the need for more space to fabricate and test big solid motors and "we have a crew out looking at sites right now." If it lands the solid *Nova* contract, Kimball says, Aerojet also would have to build a new continuous mix plant.

• **Growing to 1600**—Billed as a "major organizational move" prior to its announcement last week in Washington, Space-General is formed out of Aerojet's recently established Spacecraft Division and Space Electronics Corp., a company acquired late last year as a subsidiary.

Dr. James C. Fletcher, president of Space Electronics, is heading up Space-General; Frank W. Lehan, formerly executive vice president of Space Electronics, takes over the same post in the new organization.

Aerojet says the company is starting off with a business base this year of $20 million. It has about 800 employes and the payroll is expected to grow to 1600 by next July.

The company is presently headquartered at Space Electronics' old facilities in Glendale, Calif., but will move early next year to a 200,000-sq.-ft. plant east of Los Angeles.

Target areas of effort by the new company include, besides *Saturn S-II:* a "new type" navigational satellite; the *Vela Hotel* spacecraft for detecting nuclear explosions in space; orbital spacecraft with offensive and defensive systems; SARUS search and rescue satellite; and development of terminal guidance for ICBM warheads—as well as other advanced projects.

SPACE-GENERAL president Dr. James C. Fletcher (left) and v-p Frank W. Lehan.

• **Miniature moonmobile**—Going projects include continuation of Aerojet's *AbleStar* upper stage motor, *Aerobee* and *Astrobee* space probe vehicles and instrumentation for the *Ranger* and *Surveyor* lunar spacecraft.

S-G is planning to follow through on a proposal to NASA to build a "miniature moonmobile" weighing about 300 lbs. that could speed up lunar exploration to 1963 or sooner. It would be soft-landed with an *Atlas-Centaur* and essentially combine the functions of *Surveyor* and *Prospector*, a 1500-lb. exploratory vehicle that has been scheduled for 1966-67.

Employing a *Surveyor* landing gear, the moonmobile would be able to survey the lunar surface over a 1500-mi. range, using TV to pick out manned vehicle landing sites, as well as sample and send back to earth analyses of the lunar crust.

Aerojet expects to put several million dollars into S-G. Says Kimball:

"The new corporation represents the necessary blend of know-how in electronics, propulsion, structures, and systems concepts, as well as assembly and fabrication of missile/space systems. We decided to bet our money on it." ¤

mergers & expansions

FAIRCHILD STRATOS CORPORATION announces several division name changes. The former Astrionics Division is now the Electronic Systems Division and the company's St. Augustine, Fla., operation is now the Aircraft Service Division. In May, Fairchild changed its name from Fairchild Engine and Airplane Corp. to its present title.

WEAPONS INDUSTRY CONSULTANTS, INC. has been formed to supply market intelligence to the defense industry. Founded by John H. Kelly, the firm's staff is composed of management personnel formerly associated with defense-contract holders. Services will include a weekly Current Market Intelligence report, follow-on intelligence collection for client's specific requirements, specialized market research reporting of any technical, management, marketing, or conceptual weapons development for clients, new contract opportunities and recommendation of optimum market intelligence systems after analysis of client's firm. Home offices are at 7928 Ivanhoe St., La Jolla, Calif.

MEMOREX CORPORATION, Santa Clara, Calif., was formed to specialize in the field of electronic memory and to develop advanced materials and technology related to the field. A plant is under construction and production of high-precision magnetic tapes will be ready for marketing next year.

THE MARTIN COMPANY and American-Marietta Company have announced merger plans, pending stockholder approval. Martin board chairman George M. Bunker will be Chairman of the Board and President of the as-yet-unnamed company. Grover M. Her-

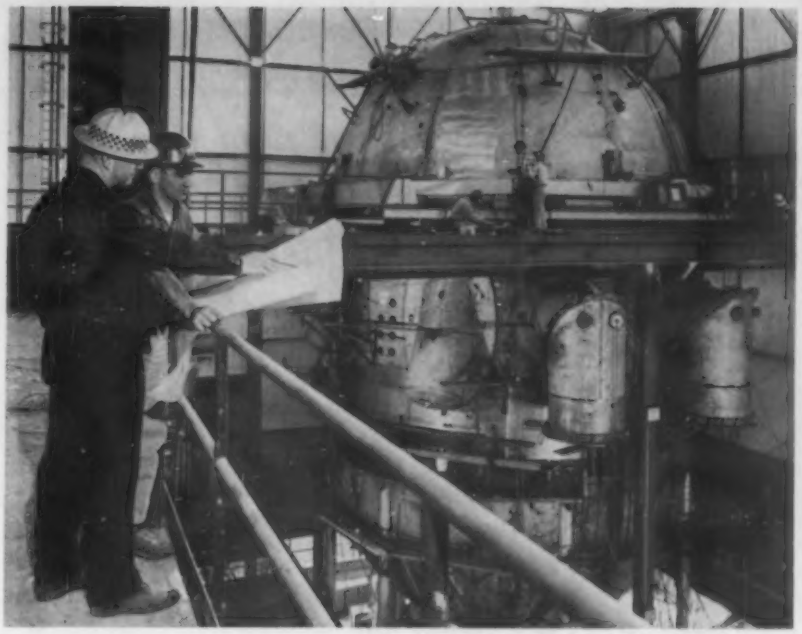
mann, Marietta Board Chairman, will be Vice President. No date has been set for a stockholders' meeting. A joint statement said "It is anticipated that the new company will be in a position to serve better its government and military customers. . . ." American-Marietta produces building supplies and other products.

SMITH THERMOTRONICS, INC., is the new name for E. C. Smith Company, Conshohocken, Pa., manufacturers of thermocouple temperature measuring elements and accessories.

DYNAMIC INSTRUMENT CORPORATION acquired Vibration Research Laboratories through exchange of stock. The parent company is a designer-manufacturer of precision magnetic clutches and brakes for applications in subsystems aboard missiles, aircraft and submarines. Vibration Research, a prime developer of solid-state power conversion equipment, developed a complete power supply system for the *Atlas, Thor* and *Jupiter* missiles.

LEAR, INC. is putting $3.5 million into a plant expansion program at its Instrument Division at Grand Rapids, Mich. Lear's first-quarter earnings this year were $510,000—about 10% over last year—on sales of $22.5 million—5% over the same period last year.

LOCKHEED AIRCRAFT CORP. renamed its missile-satellite organization the Lockheed Missiles and Space Company, and established three divisions within it—Space Systems, Missile Systems, and General Services, Lockheed President Courtlandt S. Gross said the reorganization "will provide more direct and effective communication between the company management responsible for the missile and space activities and the cognizant government agencies on one hand, and between the missiles and space organization and the corporation on the other hand." The new company will continue to operate as a division of the parent organization.



Largest U.S. Space Simulator

NEARS COMPLETION: General Electric's $6-million space environment simulation laboratory nears final construction at Valley Forge (Pa.) Space Technology Center. The 54-ft.-high simulator will be large enough to test manned vehicles and capable of producing almost total vacuum and temperatures lower than —300°F, and reproducing "effects" of solar energy in space.

WYLE LABORATORIES, El Segundo, Calif., has placed two mobile labs from its Field Service Department at U.S. Air Force bases to meet inspection and calibration requirements of advanced missile and aerospace components and systems. A 40-ft. unit at Plattsburg AFB, N.Y., is equipped to perform analysis of gases, liquid fuels and oxidizers. It incorporates an office and lab, including a separate area for microscopy. A 20-ft. standards and calibration lab in service at Chanute AFB, Rantoul, Ill., is designed to perform instrumentation calibration and checkout during control system testing and system validation.

CONTROLS COMPANY OF AMERICA formed a new Astromatic Division, with offices and plant in El Segundo, Calif. The new division had functoned as part of the Control Switch Div., but the company says increasing demand for components and systems required setting up a separate facility.

AIR PRODUCTS, INC. acquired 100% interest in its British subsidiary, Air Products Limited, through exchange of over $2.4 million cash. Leonard P. Pool, Air Products' President, said the acquisition was made "to strengthen our position in the British Commonwealth and European Common Markets." Air Products Limited, with sales over $5 million, is principally involved in design, manufacture, installation and operation of oxygen plants and other cryogenic equipment.

Financial Reports

COMPANY	PERIOD	INCOME		EARNINGS	
		1961	1960	1961	1960
Airpax Electronics	3 mo. Mar. 31	$ 1,056,979	$ 952,911	$ 27,420	$ 16,072
Ampex Corporation	Year, Apr. 30	70,105,000	73,434,000	—4,000,000	3,959,000
Amphenol-Borg	3 mo. Mar. 31	13,767,900	15,562,129	123,735	789,182
*Collins Radio Company	9 mo. Apr. 30	164,145,046	138,991,830	2,700,117	5,901,605
Dorne & Margolin Inc.	Year, Mar. 31	2,086,111	1,678,664	41,459	44,150
Laboratory for Electronics	Year, Apr. 30	50,929,000	48,114,000	1,891,000	1,648,000
Ryan Aeronautical Company	6 mo. Apr. 30	45,831,290	51,039,813	1,174,867	881,010
Sperry Rand	Year, Mar. 31	1,176,999,343	1,173,050,913	27,815,655	37,235,823

*Collins attributes lower earnings despite greater sales on R&D expenses, "unusually large" pre-production and start-up costs and facility improvement and operating processes.

Increased technical responsibilities in the field of range measurements have required the creation of new positions at the Lincoln Laboratory. We invite inquiries from senior members of the scientific community interested in participating with us in solving problems of the greatest urgency in the defense of the Nation.

RADIO PHYSICS and ASTRONOMY

RE-ENTRY PHYSICS

PENETRATION AIDS DEVELOPMENT

TARGET IDENTIFICATION RESEARCH

SYSTEMS: Space Surveillance
Strategic Communications
Integrated Data Networks

NEW RADAR TECHNIQUES

SYSTEM ANALYSIS

COMMUNICATIONS: Techniques
Psychology
Theory

INFORMATION PROCESSING

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SANGAMO ELECTRIC CO. has purchased a controlling stock interest in Microsonics Inc., of Hingham, Mass., manufacturers of delay lines. An immediate and rapid expansion of the research and development facilities of Microsonics is planned.

CAMBRIDGE SCIENTIFIC INDUSTRIES, INC., has been formed at Cambridge, Md., to design and manufacture electromechanical devices for the electronic and aircraft industries. Formation of the new firm was announced by Donald A. Holdt, former executive vice president of Airpax Electronics.

GANLON INDUSTRIES, INC., has been formed to provide research, design and production services on contract to industry and government agencies. The new Glen Cove, N.Y., firm will specialize in engineering and design of digital data handling systems, analog control systems, automatic checkout equipment and transistorized circuit design. In manufacturing service, the company will give special attention to electro-mechanical assembly, prototype wiring, cable and harness fabrication with methodized fabrication techniques and established quality control procedures.

ALPHA METALS, INC., will open a manufacturing and sales division in London next month. The new European division will supply overseas semiconductor device manufacturers with high-purity microminature metal forms, and continuous conductive solder-coated base metals for base tabs used in production of germanium devices.

reviews

ATLAS OF THE OTHER SIDE OF THE MOON, edited by N. P. Barabashov, A. A. Mikhailov, Yu N. Lipskiy, first published by the Academy of Science of the USSR; Pergamon Press, Headington Hill Hall, Oxford, England, 171 pp., $7.00.

This is a good translation of the Russian report explaining the derivation of the map of the other side of the moon. It may be remembered that information for such a map was radioed to Russian ground stations from a Soviet moon vehicle launched Oct. 4, 1959.

A GUIDE TO TECHNICAL LITERATURE PRODUCTION, Emerson Clarke. TW Publishers, Box 152, River Forest, Illinois. 180 pp., $3.

The Guide is a quite thorough handbook designed for the company buyer, producer or writer of technical literature.

It deals with the problems of personnel; number needed, how to train writers, where to recruit and what to pay them. It also covers production cost factors, and outlines possible planning schedules. There are chapters on filing systems, production operations and the use of writing agencies.

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Technical Countdown

ELECTRONICS

Recovery Problem Underestimated

Rumors persist that NASA *Apollo*-study reviewers are disappointed in the guidance and control aspects of the project as reflected in all of the submitted reports. Chief problem seems to be a general lack of real comprehension of re-entry and recovery problems. These were anticipated in the *Dyna-Soar* program by the Air Force and Boeing, who accordingly let several long-term research contracts which are now in progress. NASA has already been briefed on the results to date of these studies.

Crystal-Can Relay Size Halved

A crystal-can relay developed by Leach Corp. offers a 50% reduction in volume requirements for printed circuits. The tiny relay weighing 0.25 oz. and occupying 0.128 cu. in., frees design engineers of the need for laying relays down horizontally and requires no hold-down tabs. It employs a single-coil electromechanical circuit in place of the two coils used in conventional subminiature crystal cans.

Thin-film Functional Circuits Studied

Motorola has just received a $1.5-million AF contract to study compatible techniques for integrated circuit functions. The Semiconductor Division in Phoenix will combine semiconductor processes and thin-film technology to obtain single-crystal functional circuits. The contract is of the cost-sharing type, with Motorola bearing the brunt of the costs.

Low-Price Power Transistors Possible

A new encapsulation technique developed by Philco's Lansdale Division reportedly permits a quadruple power dissipation increase in the division's high-frequency MADT transistors. These components have wide current use in high-speed computer circuits and communications equipment. The breakthrough involves use of a medium that doubles thermal conductivity between transistor junction and base. The trick is to achieve very-high-density loading of carefully graded alumina in an inert vehicle of polysiloxane fluid which has a service range from $-100°F$ to $+400°F$. The transistors use low-priced germanium.

Reds Press Maser Research

Izvestia recently reported that Soviet scientists, using a getter-ionic pump and cooling to achieve a vacuum level of $5x10^{-9}$ mm Hg, have operated a sealed-off ammonia maser oscillator continuously for six days. By using a getter-ionic pump with a 700 liter/sec. evacuation rate, Gor'kiy University researchers say, it will be possible to operate the maser continuously for about two months.

Breakthrough in Transformer Miniaturization

Researchers are finally getting around to doing something about the size and weight of transformers—until now an anachronism in the era of miniaturized components. Dr. Richard McFee, of Syracuse University and Arthur D. Little, Inc., has found a way to utilize the advantages of superconductivity in a transformer design, while avoiding its limitations. Basically, the new technique uses interleaved layers in the transformer to cancel out the magnetic fields usually generated about the windings, which quench the superconductivity.

SUPPORT EQUIPMENT

AF Buys RACEP

The Air Force became The Martin Co.'s first customer for the new RACEP multi-channel voice communication system (M/R, June 12). Electronic Systems Division, AFSC, bought six of the newly developed units for testing as ground-to-ground links.

Missile U. Adds Courses

Army Ordnance has added three courses on the improved *Nike-Hercules* weapon system at the Redstone Arsenal missile school. The new courses are primarily concerned with the Hipar radar recently added to increase the system's effectiveness about tenfold. Curricula of the school now includes 69 courses covering eight weapon systems.

Surveillance Radar Being Mobilized

The Signal Corps has started a development program to put the TPS-25 radar on wheels, making it the first mobile ground surveillance radar. Installed in an M-257 armored amphibious carrier, the radar will be capable of speeds of 40 mph on land and 4 mph on water, and delivery by air-drop.

ADVANCED MATERIALS

Silicone Rubber for Re-Entry?

G.E. scientists have subjected silicone rubber compounds to 9000°F for six minutes. A full 70% of the material remained flexible after exposure, although a hard, carbonaceous crust formed on the surface. Temperatures behind the sample reached only 450°F.

Disappearing Conductor

Molybdenum trioxide, formed when the metal reaches 1500°F in air, acts as a conductor and short-circuits electrical systems. When returned to room temperature, the oxide becomes an insulator. Boeing engineers discovered the phenomenon during simulated *Dyna-Soar* space flights. Even small quantities of the vapor escaping from tiny cracks in the moly protective coating could penetrate high-quality aircraft wiring.

Liquid Hydrogen Construction Begins

Chemical Construction Corp. is erecting Linde's multi-million-dollar liquid hydrogen plant at Fontana, Calif. Scheduled for completion by June, 1962, the plant will supply 21 tons a day to West Coast rocket centers under a $31-million NASA contract with Linde Co.

Electrically Boosted Flames

An economical heat source capable of supplying energy in the 3000° to 6000°F range has been patented by an engineer at Arthur D. Little, Inc. The concept involves boosting the energy from fuel-oxidant combustion by superimposing electrical energy on the flame from a low-current, high-voltage, a-c discharge.

Need for Universal Checkout is Questioned

Martin study of predictable requirements of big weapon systems indicates that cost would make it impractical

by Charles D. LaFond

BALTIMORE—A Martin Co. study is tossing cold water on the need for a truly universal checkout system.

Looking over basic weapon parameters up through 1975 for the Air Force, the study finds few systems which would combine to make a universal checker practical.

Cost of a three-weapon checker in use, the study notes, would be more than double the total expenditure for three separate integrated, automatic and special-purpose checkout systems.

• **Studies unfunded**—In late 1960, the Air Force initiated four unfunded study projects for "Design Criteria for Automatic Test and Checkout Systems."

Martin's Electronics Division, Minneapolis-Honeywell, Nortronics Division of Northrop Corp., and a Motorola/Douglas team were selected to participate in the study. Each of the four studies was conducted independently, and the Air Force provided the participants with unusually broad need-to-know clearance.

Five primary objectives were sought in the seven-month studies:

1. To validate requirements for test and checkout across the spectrum for future weapon and space systems for a period ending in 1975. Air Force, Navy, Army and National Aeronautics and Space Administration systems—operational, R&D, and conceptual—were covered.

2. To corroborate design criteria which would assure compatibility of all future weapon systems, checkout, and associated test equipment.

3. To determine feasibility of standardizing components and techniques in test and checkout systems.

4. To determine feasibility of designing an integrated, multipurpose, automatic test and checkout system or family of systems.

5. To analyze cost versus increased weapon system effectiveness in support of any conclusions and recommendations resulting from each study.

• **Martin approach**—In its approach to the checkout study, Martin employed nine separate teams of engineers drawn from its divisions in Baltimore, Denver, Orlando, and Cocoa. The whole group was under the direction of W. O. Campbell of the company's GSE Department, Electronics Division, in Baltimore.

During the course of the study, Campbell said, he and his teams interviewed hundreds of specialists in all of the military services, NASA, and various laboratories throughout the country. In addition, they surveyed over 200 technical publications for pertinent data.

Only major conceptual weapons systems were considered, because of their inherent diversity and complexity. Campbell, for his investigations, chose nine representative systems: two manned space vehicles, five missiles, and two aircraft. He described these as:

—A manned space platform (similar to *Apollo*).

—A *Dyna-Soar X*, described as an advanced follow-on type from the current AF program.

—Two super ICBM's, one mobile and one for a fixed hardened base (advanced versions of *Atlas, Titan, Minuteman*).

—A tactical ballistic missile such as *Pershing*.

—A *Nike-Zeus*-type AICBM.

—A *Skybolt*-type ALBM.

—A B-70 follow-on vehicle.

—And finally, a V/STOL (vertical or short takeoff and landing aircraft). One study team was assigned to each system.

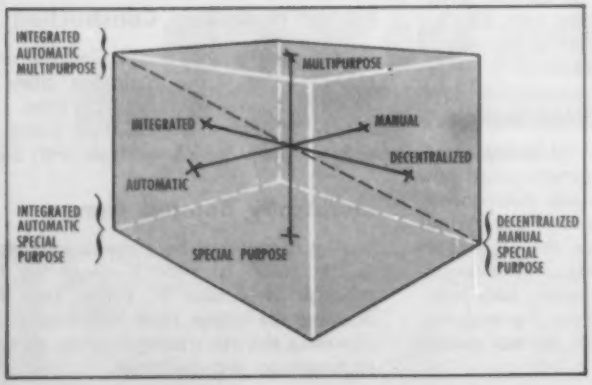
• **The Golden Cube**—As a result of its study, Martin-Electronics believes it has originated a unique management tool for use in selecting the correct checkout concept for any given weapon system. Called the "Golden Cube," it is based on a three-dimensional graphic approach for relating key weapon system/checkout parameters.

During the course of the study, a general checkout model was deduced by members of the group by reducing all known system configurations to three basic parameters: 1. degree of automaticity; 2. degree of checkout capability (from special purpose to multipurpose); and 3. degree of integration. Since these were considered mutually independent checkout ideas, they could be plotted on an X-Y-Z diagram.

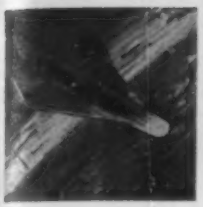
Also, it was determined that all known weapon-system checkout situations could be reduced to three parameters: 1. workload requirement; 2. degree of weapon-system design firmness; and 3. degree of integration of subsystems within the weapon system. Most significant, however, was the fact that these parameters too were mutually independent and they co-related one-to-one with the three checkout parameters.

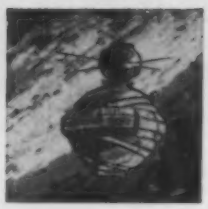
Once these fundamental concepts

(Continued on page 31)



"GOLDEN CUBE" developed by Martin-Electronics in study of future Air Force checkout needs. The three basic parameters can be weighted, Martin says, and by three-dimensional plotting, a precise model of the required system configuration can be deduced.





JULY, 1961

MISSILES and ROCKETS

ASTROLOG

Current status of U. S. missile and space programs plus all orbiting satellites

Satellites and Spacecraft

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★**ADVENT** (Army)	Army Signal Corps, prime; Bendix prime for 24-hour satellite communications package; GE, vehicle	Twenty-four hour instantaneous repeater communications satellite; more than 1250 lbs.; program incorporates Projects STEER, DECREE and COURIER	R&D; ground sites to be equipped at Ft. Dix, N.J., and Camp Roberts, Calif.; shipboard terminals also being designed; first ATLAS-CENTAUR launchings late '62; may use TITAN II space booster
ANNA (Army, Navy, AF, NASA)	No contractors announced	Geodetic satellite; 50-100 lbs.; probably spherical	Study completed; R&D program appears imminent
AEROS (NASA)	No contract announced	24-hour weather satellite to be boosted by CENTAUR	Planning. First flights would be in 1964 or 1965; unfunded FY '62 budget; TV camera R&D to begin soon
★**APOLLO** (NASA)	Convair, Martin, GE	Three-man spacecraft capable of orbiting moon or becoming space station; probably winged for lunar flights; boosted by SATURN	Studies completed; program greatly accelerated; contractor briefings mid-summer
ARENTS (ARPA)	Convair, prime	Satellites to investigate deep space; 22,000 n. orbits; ATLAS-CENTAUR booster	Contract let to build three payloads; launchings begin early '62
ASP (Air Force)	No contracts announced	Aerospace plane, a manned spacecraft capable of operating in the atmosphere and space	Study
BAMBI (ARPA)	Convair, STL	Satellite system capable of intercepting enemy missiles in boost phase	Studies
CSAR (Air Force)	No contracts announced	Communications satellite system; satellites to weigh possibly two tons; to use passive lens reflectors	Studies; possibly operational mid-60's
★**DISCOVERER** (Air Force)	Lockheed, prime; GE, re-entry vehicle	THOR-AGENA and ATLAS-AGENA launchings of early stabilized satellites; main purpose is to test techniques for military space systems	Launchings: 25; 6 capsules recovered from orbit (3 air-snatched); after orbiting earth one to three days; plans to put simians in capsules delayed
★**DYNA-SOAR I** (Air Force)	Boeing, spacecraft and systems integrator; Martin, propulsion; Minneapolis-Honeywell, guidance; RCA, communications data link	Boost-glide orbital spacecraft; R&D leading to first space bomber; TITAN II booster; 3rd powered stage to be added	R&D; first glider flights from Edwards AFB 1962; R&D suborbital flight about early 1963; program accelerated somewhat under FY '62 budget
ECHO (NASA)	Langley Research Center, prime	ECHO I: 100 ft. inflatable sphere in 1000 mile orbit; passive communication satellite; ECHO II: 135-ft., 700-mi. orbit	In orbit since Aug. 12, 1960; ECHO II scheduled to be launched 1962; suborbital tests late '61

★ Indicates change since May 1961 Astrolog

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
MARINER (NASA)	JPL, prime	600-1200 lb. unmanned spacecraft for early interplanetary missions; boosted by ATLAS-AGENA B	Seven shots planned. First scheduled Venus fly-by Aug. 1962
★**MERCURY** (NASA)	McDonnell, capsule	First U.S. manned satellite; 2500 lb. capsule; ATLAS boosted	First manned orbit shot expected late 1961 or early 1962. First manned sub-orbital launching with REDSTONE May 5
MIDAS (Air Force)	Lockheed, prime; Aerojet, IR detector system	Early-warning satellite; detect ICBM launchings by infrared before birds leave pad; R&D models weigh 2.5 tons; operational system to have 12-15 satellites	R&D; second launching May 24, 1960 partial success; components being tested by DISCOVERER
NIMBUS (NASA)	GE, prime	2nd generation weather satellite; 650 lbs.; 6 TV cameras in payload; THOR-AGENA B booster	First launching scheduled for late 1962
OAO (NASA)	Grumman, prime; Westinghouse, electronic components; GE, stabilization and control	3500-lb. orbiting astronomical satellite observatory equipped with telescope; boosted by ATLAS-AGENA B	First flight scheduled in late 1963 or 1964
OGO (NASA)	Space Technology Laboratories, prime	1000-lb. satellites with instruments for geophysical measurements; polar (POGO) and eccentric (EGO) shots planned; ATLAS-AGENA B, THOR-AGENA B, CENTAUR boosters	First flight scheduled in 1963
OSO (NASA)	Ball Brothers, prime	350-lb. orbiting solar observatory; THOR-DELTA booster	First flight planned summer 1961
PROSPECTOR (NASA)	No contract announced	Soft-landed, remote control, unmanned moon exploring spacecraft; SATURN booster	First flight planned by 1965; study contracts to be awarded in 1961
RANGER (NASA)	JPL, prime; Aeronutronic, capsule; Hercules, retrorocket	300-lb. instrumented capsule rough landed on moon; ATLAS-AGENA B booster	R&D; first flight planned 1961; first lunar landing planned for 1962, instrumentation to include seismometer.
REBOUND (NASA)	No contract announced	System of 3 to 6 multi-launched ECHO II communications satellites	First orbital flight scheduled for 1963 or 1964
★**RELAY** (NASA)	RCA, prime	100-lb. active repeater communications satellites. Commercial system planned; DELTA launched	Both Britain and France to take part in program; Latin American interest sought
SAINT (Air Force)	RCA, prime	Anti-satellite satellite inspection system; to be complemented by interception system; about 2 tons; ATLAS launched	R&D underway; to be launched against reflectors or balloons in 400-mi. orbits late '61
SAMOS (Air Force)	Lockheed, prime	Reconnaissance satellite; formerly SENTRY; R&D model weighs 4100 lbs.	R&D; SAMOS II successfully launched Jan. 31 from Vandenberg. First launch failed to put SAMOS in orbit Oct. 11; scheduled to be operational late 1962, early 1963 under new, bigger program; components being tested in DISCOVERERS
SLOMAR (Air Force)	Lockheed and Martin, prime	Logistics, maintenance, supply spacecraft for space systems	Study contracts awarded in December
SURVEYOR (NASA)	Hughes, prime	750-lb. spacecraft soft-landing 100-300 lbs. instruments on moon; ATLAS-CENTAUR booster	First moon flights 1963; seven to be launched by 1965
TIROS (NASA-AF-Army-Navy-Wea. Bu.)	RCA-Army Signal Corps, prime	Meteorological satellite; TV pictures of cloud cover; TIROS II carried IR scanner	R&D; first launching last April; second Nov. 23, both successful. At least one more planned
TRANSIT (Navy)	Applied Physics Laboratory, prime	Navigational satellite; R&D model weighs more than 250 lbs.; operational model about 50-100 lbs.	TRANSIT IB R&D satellite in orbit April 13; 11A plus piggyback satellite in orbit June 22; TRANSIT IIIB launched into poor orbit Feb. 21; four-satellite system scheduled to be in orbit 1962
VOYAGER (NASA)	No contract announced	Unmanned spacecraft to orbit Mars or Venus; eject capsule for re-entry; SATURN booster	Study; first flight planned by 1965
YO YO (Navy)	No contract announced	Tactical sea-launched one-pass reconnaissance satelloid	R&D
★**X-15** (NASA-AF-Navy)	North American, prime; Thiokol, propulsion	Rocket plane; 4000 mph; flight at edge of space; an AF model each XLR-11 rocket engine develops 16,000 lbs. of thrust; XLR-99 engines 50,000 lbs. Three planes delivered.	Powered flights in progress; plane #1 has hit Mach 3 and more than 136,500 ft. with XLR-11 engine; plane #2 with XLR-99 engine turned over to NASA; has hit 3690 mph speed record; altitude record of 169,600 ft. (unofficial for manned, powered flight)

Missiles and Rockets

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
ALFA (Navy)	Navy, prime; Avco, air frame	ASW surface-to-underwater; 500 lb. solid; conventional	Deployed on destroyer escorts
ARM (Navy)	No contract announced	Anti-radar missile; air to surface	R&D; AF anti-radar missile by same name at least temporarily shelved
ASROC (Navy)	Minneapolis-Honeywell, prime; Sangamo Electric, sonar; torpedo, GE; depth charge, M-H	Surface-to-underwater; solid rocket torpedo or depth charge; nuclear or conventional, range about 8 miles; advanced ASROC (improved Mark 44 torpedo) under R&D	R&D; operational on Destroyers Norfolk, Adams, Dewey and Perry; plans call for deploying on 150 destroyers and cruisers
ASTOR (Navy)	Westinghouse, prime	ASW underwater to underwater rocket torpedo; nuclear	R&D
★**ATLAS** (Air Force)	Convair, prime; GE/Burroughs, Arma, guidance; Rocketdyne, propulsion; GE/Avco, re-entry vehicle	ICBM; more than 5500-to-7500 mile range; liquid; nuclear; ATLAS "E" series has inertial guidance; earlier ATLAS "D" has radio inertial; proposed ATLAS "G" would have 900,000-lb. thrust and 4000-lb. payload capability	86 launchings; 56 successes, 20 partial, 10 failures; 11 bases for 13 squadrons; operational at Vandenberg and Warren; ATLAS E tests began Oct. 11; about 18 to 21 launchers operational—40 to 60 expected in 1961. First successful "E" shot Feb. 24
BOMARC-A (Air Force)	Boeing, prime; IBM/Westinghouse, guidance; Aerojet/Marquardt, propulsion	Ramjet surface-to-air interceptor; liquid booster; 250 m. range; Mach 2.7; nuclear	Five bases operational in Northeastern U.S. from Virginia to Maine
BOMARC-B (Air Force)	Boeing, prime; Kearfott/Westinghouse, IBM Guidance; Thiokol/Marquardt, propulsion	Ramjet, surface-to-air; solid booster; Mach 2.7; more than 400 m. range; nuclear	B models being produced; a B test bird intercepted simulated target 345 miles away Oct. 14; to be deployed at 6 U.S. bases, two in Canada
BULLPUP (Navy-Air Force)	Martin, prime; Martin, guidance; Thiokol, Naval Propellant Plant, propulsion; Maxson, second-source prime	Air-to-surface; 3-6 mile range; conventional 250-1000-lb. bomb; new model has pre-packaged liquid; nuclear-tipped model nearly operational; AF designation: GAM 83-A (HE warhead), GAM 83-B (nuclear)	Deployed with Atlantic and Pacific Fleets; bigger model under R&D; soon operational with Air Force units. Marines launching BULLPUP from helicopters
COBRA (Navy)	No contract announced	Anti-ship radar missile	Early R&D
COBRA (Marines)	Boelkow Entwicklungen, West Germany, prime manufacturer; Daystrom, U.S. licensee	20.2-pound anti-tank missile; 1 mile range; 191 mph speed; solid propellant	Marines planning to purchase; Army considering them; already operational with West German troops
CORPORAL (Army)	Firestone, prime; Gilfillan, guidance; Ryan, propulsion	Surface-to-surface; 75-mile range; liquid; nuclear	Deployed with U.S. & NATO troops in Europe
CROW (Navy)	No contract announced	Air-to-air missile	R&D; has been flight tested
★**DAVY CROCKETT** (Army)	In-house project directed by Rock Island, Ill., arsenal	Surface-to-surface; solid; bazooka launched; sub-kiloton nuclear warhead; two launchers of different size for various ranges; vehicle mounted or carried by two men	Late R&D; deployment delayed until 1962
ENTAC (Army)	Nord Aviation, prime	Anti-tank; 6600-ft. range; 37 lbs.; HE warhead; wire-guided.	Operational; Army buying from French in quantity
FABMIDS (Army)	Convair, Hughes, Martin, GE, Raytheon, Sylvania—feasibility studies	Mobile anti-missile defense system	Each of six contractors have $250,000 feasibility study contracts awarded Oct. 10; reports expected mid-'61
FALCON (Air Force)	Hughes, prime; Hughes, guidance; Thiokol, propulsion	Air-to-air; 5-mile range; Mach 2; solid; conventional; GAR-11 has nuclear warhead	GAR-1 through GAR-4 operational; GAR-9 R&D; GAR-11 operational in near future; buy-out of GAR 3A, 4A and 11 in FY '62
GENIE (Air Force)	Douglas, prime; Aerojet-General, propulsion	Air-to-air unguided; 1.5-mile range; nuclear	Operational
GIMLET (Navy)	No contract announced	Air-to-surface; unguided; considered highly accurate	R&D
HAWK (Army)	Raytheon, prime; Raytheon, guidance; Aerojet-General, propulsion	Surface-to-air; 22-mile range; solid; conventional; designed to hit low-flying planes	Operational; deployed at Panama, Okinawa; SUPER HAWK under development; Jan. 29, 1960 successfully intercepted HONEST JOHN, first known missile intercept of another

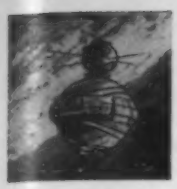
PROJECT	CONTRACTORS	DESCRIPTION	STATUS
HONEST JOHN (Army)	Douglas/Emerson Electric, prime; Hercules, propulsion	Surface-to-surface; unguided; 12-mile range; nuclear	Operational; deployed in Europe
HOUND DOG (Air Force)	North American, prime; Autonetics, guidance; Pratt and Whitney, propulsion	Air breathing air-to-surface; 500-mile range; Mach 1.7; turbojet; nuclear	Operational; to be launched from B-52G intercontinental bombers; stockpile expected to exceed 400
JUPITER (Army)	Chrysler, prime; Ford Instrument, guidance; Rocketdyne, propulsion; Goodyear/CTL, re-entry vehicle	IRBM; liquid; nuclear; can be made mobile	To be deployed with Italian and Turkish troops. 31 military launchings: 24 successes; 5 partials; 2 failures. Full tactical GSE used for first time in Oct. 20 shot from Cape
LACROSSE (Army)	Martin, prime; Martin, guidance; Thiokol, propulsion	Surface-to-surface; highly mobile; 20-mile range; solid; nuclear	Operational; three units deployed in Europe; more being trained; advanced LACROSSE R&D dropped
LAW (Army)	Hesse-Eastern Div., Flightex Fabrics, prime	Light anti-tank rocket; carrier tube launcher; 4.5 lbs.; 25 in. long/3 in. diameter	R&D under AOMC
LITTLE JOHN (Army)	Emerson Electric, prime; Hercules Powder, propulsion	Surface-to-surface; unguided; 10-mile range; solid; nuclear	First 4-launcher battalion operational this winter
LOBBER (Army)	No contract announced	Surface-to-surface; cargo carrier; 10-15 mile range; also can drop napalm; LOBBER with warhead called BALLISTA	Studies
LULU (Navy)	General Mills/Naval Ordnance Lab, prime	Small nuclear depth charge air-dropped or launched by ASROC	Operational
★**MACE** (Air Force)	Martin, prime; Goodyear/AC Spark Plug, guidance; Thiokol/Allison, propulsion	Air-breathing surface-to-surface; more than 650-mile range; turbojet & solid-nuclear; B model has more than 1200 mile range	Being deployed with U.S. troops in West Germany; now all mobile but hard-base version development completed; to be in Okinawa, Korea
MATADOR (Air Force)	Martin, prime; Thiokol/Allison, propulsion	Air-breathing surface-to-surface; 650 mile range	Being turned over to West Germans; also deployed in Far East
MAULER (Army)	Convair, prime	Surface-to-air; radar guidance; highly mobile antiaircraft and antimissile missile for field use; on tracked vehicle; 12 missiles per launcher	R&D; NATO may buy
★**MINUTEMAN** (Air Force)	Boeing, major contractor; Autonetics, guidance; Thiokol, propulsion first stage; Aerojet, propulsion second stage; Hercules, third stage; Avco, re-entry vehicle; AMF-ACF, rail launcher	2nd generation ICBM; solid; fixed or mobile aboard railroad trains; nuclear; 3 stages	R&D; scheduled to be operational mid-1962 at Malmstrom AFB; first R&D flight (all stages igniting) from Cape Feb. 1 a success; 2nd launching May 19 a partial success; tactical rail system tests completed; 3 squadrons at Malstrom, Mont.; Ellsworth, S. D.; Whitman, Mo.; Minot, N. D. 12 fixed squadrons now planned; mobile system indefinitely postponed
M-55 (Army)	Norris Thermador, prime	Four-inch diameter, small, short-range poison gas rockets; to be fired from 45-tube launchers	Operational
MISSILE A (Army)	ARGMA, prime	Surface-to-surface; 10-20 mile range; solid	Design studies
NIKE-AJAX (Army)	Western Electric, prime; Western Electric, guidance; Thiokol, propulsion; Douglas, airframe	Surface-to-air; 25-mile range; Mach 2.5; solid & liquid; conventional	Deployed in U.S., Europe & Far East; about 170 batteries in U.S., sixty-eight more to be phased out and replaced with NIKE-HERCULES
NIKE-HERCULES (Army)	Western Electric, prime; Western Electric, guidance; Hercules & Thiokol, propulsion; Douglas, airframe	Surface-to-air; 75-mile range; Mach 3+; nuclear; anti-aircraft, tactical missiles; mobile or fixed	Rapidly replacing NIKE-AJAX; well over 80 batteries deployed in U.S.; more than 10 N-H batteries being deployed overseas in 1961; N-H on Formosa
NIKE-ZEUS (Army)	Western Electric, prime; Bell Telephone, guidance; Thiokol/Grand Central, propulsion; Douglas, airframe	Anti-missile; 3-stage; 200-mile range; solid; nuclear	R&D test launchings at White Sands, 14 R&D launchings; 8 successful, 4 partial, 2 failures. Complete system tests now scheduled for early '62
★**PERSHING** (Army)	Martin, prime; Bendix, guidance, Thiokol, propulsion	Surface-to-surface; two-stage solid; approx. 500-mile range; nuclear; transported on FMC XM474 tracked vehicle; proposed PERSHING II would have 1000-mile range	R&D; to replace REDSTONE; 17 R&D launchings: 14 successes (both stages launched, guidance carried as passenger Dec. 12 for first time), 3 failures. Operational late 1961; R&D launching about 250 miles April 21

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★**POLARIS** (Navy)	Lockheed, prime; GE/MIT, guidance and fire control; Aerojet-General, propulsion; Lockheed, re-entry vehicle	Underwater and surface-to-surface; solid; 1200-mile range can hit more than 90% all targets in Russia; nuclear; POLARIS II (1500-mile range) and SUPER POLARIS (2500 mile range) under R&D	98 launchings of test vehicles; 65 successes; 22 partial; 5 failures; 25 also launched from submerged subs—all cleared surface; 17 successful flights, 8 failures. Two subs each with 16 missiles operational, 3rd deploying this spring. Total authorized by White House: 29. POLARISES for cruiser Long Beach cancelled; Polaris II R&D missiles impacting 1400+ n.mi. in guided flight
QUAIL (Air Force)	McDonnell, prime; Summers Gyro, guidance; GE, propulsion; Ramo-Wooldridge, ECM equipment	ECM-carrying bomber decoy; about 200 m. range; jet powered	Deployed at SAC bases; carried by B-52
RAVEN (Navy)	No contract announced	Air-to-surface; about 500-mile range	Study
★**REDEYE** (Army)	Convair, prime; Philco/Convair Atlantic Research, propulsion	Surface-to-air; 4-foot, 20-lb. bazooka-type; IR guidance; solid; conventional; container-launcher disposable	Late R&D; deployment delayed until late 1962; Marines also will use; NATO may buy
REDSTONE (Army)	Chrysler, prime; Ford Instrument, guidance; Rocketdyne, propulsion	Surface-to-surface; liquid; 200-mile range; nuclear	Deployed with U.S. troops in Europe; to be replaced by PERSHING
REGULUS I (Navy)	Chance Vought, prime and guidance; Aerojet-General, propulsion	Surface-to-surface; turbojet & solid; 500-mile range; nuclear	Deployed aboard U.S. submarines; REGULUS II used as target drone
SEMPER (Marines)	No contracts announced	Believed to be an air-launched missile	R&D testing at Pt. Mugu
SERGEANT (Army)	Sperry, prime; Sperry, guidance; Thiokol, propulsion	Surface-to-surface; solid; more than 75-mile range; nuclear	In production
SHILLELAGH (Army)	Aeronutronic, prime	Surface-to-surface; lightweight; can be vehicle-mounted	Early R&D
SIDEWINDER (Navy-Air Force)	GE-Philco, prime; Philco/GE guidance; Naval Powder Plant, propulsion	Air-to-air; IR guidance; more than 2 m. range; conventional; new I-C models to have switchable IR and radar-guided warheads	Deployed with Navy and Air Force; all-weather type under development
SKYBOLT (Air Force)	Douglas, prime; Nortronics, guidance; Aerojet, propulsion; GE, re-entry vehicle	ALBM; more than 1000-mile range; solid; nuclear; to be launched from B-52, B-70 and Vulcan bombers	R&D; to be purchased by British; operational 1964; test-launching to be from Eglin AFB, Fla. Add. funding restores old operational date
SLAM (Air Force)	No contract announced	Surface-to-surface; low-altitude; supersonic; nuclear ramjet and warhead	Study-R&D
★**SNARK** (Air Force)	Norair, prime; Northrop, guidance; Pratt & Whitney/ABL, propulsion	Surface-to-surface; 5500-mile range; solid and turbojet; Mach .9; nuclear	One squadron of 30 missiles at Presque Isle, Maine; being disbanded
SPARROW III (Navy)	Raytheon, prime; Raytheon, guidance; Aerojet-General, Thiokol propulsion	Air-to-air; 5-8 mile range; Mach 2.5-3; solid and pre-packaged liquid; conventional	Operational with carrier aircraft earlier SPARROW I obsolete; new contract extending range, altitude
SUBROC (Navy)	Goodyear, prime; Kearfott, guidance; Thiokol, propulsion	Underwater or surface-to-underwater; 25-30 mile range; solid; nuclear	Estimated operational date: 1961. To be installed first on Thresher nuclear-powered attack submarine
SS-10 (Army)	Nord Aviation, prime; GE, U.S. licensee	Surface-to-surface; primarily antitank; 1600-yards range; 33 lbs. solid; wire guided; conventional	Operational with U.S., French and other NATO and Western units; battle-tested in North Africa
SS-11 (Army)	Nord Aviation, prime; G.E., U.S. licensee	Surface-to-surface; also helicopter-to-surface; 3800-yard range; 63 lbs; wire guided; conventional	Operational. Under evaluation by Army; decision on procurement due for some time
TALOS (Navy)	Bendix, prime; Bendix/Sperry, guidance; Naval Propellant Plant, propulsion	Surface-to-surface; 65-mile range; solid & ramjet; Mach 2.5; nuclear	Operational aboard cruiser Galveston
TARTAR (Navy)	Convair, prime; Raytheon, guidance; Aerojet-General, propulsion	Surface-to-air; 10-mile range; Mach 2; 15 feet long & 1 foot in diameter; solid dual-thrust motor; conventional	Operational on Missile Destroyer Adams in Oct.
TERNE (Navy)	Kongsberg Vapenfabrikk, prime; Arma, systems integration	Surface-to-underwater ASW missile; 264 lbs; HE warhead	Navy buying from Norway to equip two destroyer escorts
TERRIER (Navy)	Convair, prime; Reeves/FTL, Sperry guidance; ABL, propulsion	Surface-to-air; 10-mile range; Mach 2.5; 27 feet long; solid conventional	Operational with fleet
TERRIER-ADVANCED (Navy)	Convair, prime; Reeves/FTL, Sperry guidance; ABL, propulsion	About 100% performance improvement over TERRIER	Operational with fleet; being deployed on destroyers and carriers
★**THOR** (Air Force)	Douglas, prime; AC Spark Plug, guidance; Rocketdyne, propulsion; GE re-entry vehicle	Surface-to-surface IRBM; 1500-mile range; liquid; nuclear	Operational; 4 bases set up in England. 66 military launchings: 45 successes; 11 partial; 10 failures. 49 scientific launchings: 41 successful, 2 partial; 6 failures

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★**TITAN** (Air Force)	Martin, prime; Bell/Sperry, TITAN I guidance; AC Spark Plug, TITAN II guidance; Aerojet-General, propulsion; Avco, TITAN I re-entry vehicle; GE, TITAN II re-entry vehicle	Surface-to-surface ICBM; 5500-mile range; liquid; 90 feet long; nuclear; TITAN I burns LOX-Kerosene; TITAN II has storable propellants, inertial guidance, bigger payload, greater range, 115 ft. long TITAN III proposed	34 launchings test vehicles: 23 successes; 7 partial; 4 failures. 8 bases for 12 squadrons planned; TITAN I scheduled to be operational mid-1961; TITAN II scheduled operational early 1963; first silo launch was scheduled in May; first TITAN II in Nov.
TYPHON (Navy)	Westinghouse, prime; Bendix propulsion	Medium and long range seagoing anti-missile missiles; formerly called SUPER TARTAR and SUPER TALOS; solid booster and ramjet sustainer; conventional; supersonic	Early R&D; may be used on hydrofoil destroyers
★**WAGTAIL** (Air Force)	Minneapolis-Honeywell, prime	Family of airborne RLM's (rear-launched missiles): air-to-air and air-to-surface	Late R&D
WILLOW (Army)	Chrysler, prime	Highly-classified missile	R&D
ZUNI (Navy)	Naval Ordnance Test Station, prime Hunter-Douglas, propulsion	Air-to-air, air-to-surface; solid; unguided; 5-m. range; conventional	Operational

Space Vehicles

AGENA (Air Force)	Lockheed, prime; Bell, propulsion	1700-pound satellite after burnout; AGENA B stop-start 2450-lb. engine; about double fuel capacity of AGENA A	Used in DISCOVERER program; larger AGENA B also to be used with ATLAS and THOR
BLUE SCOUT (Air Force)	Aeronutronic, prime; Minneapolis-Honeywell, guidance; Aerojet/Hercules, Thiokol, propulsion	Solid multi-stage booster based on SCOUT components	Launchings 3: 2 successes; 1 partial
CENTAUR (NASA)	Convair, prime; Pratt & Whitney, propulsion; Minneapolis-Honeywell, guidance	Pair of LOX-liquid hydrogen engines; 30,000 lbs. total thrust, atop ATLAS booster, capable orbiting 8500 lbs. launching 1450-lb. space probe.	First test flight in 1961; first engine delivered
DELTA (NASA)	Douglas, booster; Bell, guidance; Rocketdyne/Aerojet/ABL, propulsion	Successor to THOR-ABLE; upper stage guidance; 480 lb. payload capacity	Interim launch vehicle for TIROS-ECHO; being used for other satellites and one deep space probe
JUNO II (NASA)	Marshall Center/Chrysler, prime; Ford instrument, guid.; Rocketdyne/JPL, propulsion	Early deep space booster; small payload	Phasing out
★**NOVA-L** (NASA)	No prime announced; Rocketdyne, propulsion	Clustered 6-12 million lb. liquid propellant booster plus upper stages	R&D on 1.5 million lb. F-1 engines; vehicle contract expected to be awarded this fall
★**NOVA-S** (Air Force)	No contractor announced; expected to be based on Aerojet/Grand Central feasibility studies	Clustered 12-million lb. booster; possible alternative to Nova-L	R&D; contracts expected to be let quickly
ORION (Air Force)	General Atomic	Space booster launched by series of atomic explosions	Advanced engineering studies under way; tests may be attempted
PHOENIX (Air Force)	No contracts announced	Recoverable booster—possibly a modified F-1	Studies
ROVER (NASA, AEC)	No prime announced	First nuclear rocket: KIWI non-flying test engines and NERVA flight engines	Contracts to be let this year
SATURN (NASA)	Marshall Center, prime and booster; Douglas and Convair, upper stages; Rocketdyne, booster and mid-stage engines; Pratt & Whitney, top-stage engines	Series of multistage vehicles based on 1.5-million-lb. clustered booster and various upper stages of LOX-liquid hydrogen engines. Early model to orbit 20,000-lb. payload	Second static tests ended; flight booster to be static-tested this spring for summer flight; flight with live upper stages scheduled 1963
SCOUT (NASA)	Chance Vought, prime; Minneapolis-Honeywell, guidance; Aerojet-General/Hercules/Thiokol/ABL, propulsion	Solid four-stage satellite launcher; 200 lb. payload in orbit	SCOUT 4 launched. EXPLORER IX Feb. 16. Four more SCOUT flights in '61 completes R&D; Navy proposing SEA-SCOUT for seaborne surface launch, would be based on POLARIS and SCOUT
THOR-ABLESTAR (Air Force-NASA)	STL, prime; Rocketdyne/Aerojet-General/ABL, propulsion	Three-stage vehicle, orbital capability 800 lbs. Upper stage has restart engine	THOR-ABLE phased out. THOR-ABLESTAR operational in TRANSIT and COURIER



Satellites in Orbit

★**EXPLORER I** (30.8 lbs.) U.S. Launched 1/31/58, est. life 7-10 years. Orbits earth; perigee 217 m., apogee 1120 m., period 106.6 min. (Discovered Van Allen Belt); not transmitting.

★**VANGUARD I** (3.25 lbs.) U.S. Launched 3/17/58, est. life 200-1000 years. Orbits earth; perigee 404, apogee 2455, period 133.9; transmitting.

LUNIK I "MECHTA" (3245 lbs!) Russia, Launched 1/2/59. Believed to be in orbit around Sun on 15-mo. cycle; not transmitting.

VANGUARD II (20.7 lbs.) U.S. Launched 2/17/59, est. life 100-250 years. Orbits earth but is "wobbling"; perigee 343, apogee 2052, period 125.4; inclination to equator 32.88°; not transmitting.

PIONEER IV (13.4 lbs.) U.S. Launched 3/3/59. Orbits Sun, and achieved primary mission—earth-moon trajectory; not transmitting.

EXPLORER VI "PADDLEWHEEL" (142 lbs.) U.S. Launched 8/7/59, est. life to Aug., 1961. Orbits earth; initial perigee 156, initial apogee 26,357, initial period 12½ hrs. present orbit uncertain.

★**VANGUARD III** (about 100 lbs.) U.S. Launched 9/18/59, est. life 50-150 years. Orbits earth; perigee 322, apogee 2318, period 129.8; not transmitting.

★**EXPLORER VII** (91.5 lbs.) U.S. Launched 10/13/59, est. life 30-40 years. Orbits earth; perigee 344, apogee 669, period 101.1; transmitting.

PIONEER V (94.8 lbs.) U.S. Launched 3/11/60, est. life forever. Orbits Sun, interplanetary environment probe; completed one full orbit 1/16/61; aphelion .9931 au, perihelion .8061 au; not transmitting.

★**TIROS I** (270 lbs.) U.S. Launched 4/1/60, est. life 50-150 years. Orbits earth; picture-taking weather satellite; perigee 429, apogee 467, period 99.1; transmitting.

★**TRANSIT IB** (265 lbs.) U.S. Launched 4/13/60, est. life 6 years. Orbits earth; perigee 229, apogee 417, period 95.0. First R&D navigation satellite. Not transmitting.

★**SPUTNIK IV** (10,008 lbs.) Russia. Launched 5/15/60, est. life 2-3 years. Orbits earth; initial perigee 188, apogee 229—changed to 191/429 on 5/19/60; last reported—perigee 175, apogee 322, period 92.6. Test of support systems, cabin, for manned space flight; attempt to return from orbit failed; payload, case and two pieces now in orbit. Not transmitting.

★**MIDAS II** (5000 lbs.) U.S. Launched 5/24/60, est. life 8-15 years. Orbits earth; perigee 297, apogee 315, period 94.3 Telemetry for IR scanning failed two days after launch. Transmitting.

★**TRANSIT II-A** (223 lbs.) U.S. Launched 6/22/60, est. life 50-200 years. Orbits earth, perigee 389, apogee 649, period 101.6. Transmitting.

NRL SOLAR RADIATION SATELLITE I (40 lbs.) U.S. Launched 6/22/60 with TRANSIT II-A, est. life 50-200 years. Orbits earth; perigee 381, apogee 657, period 101.6. Not transmitting.

★**ECHO I** (132 lbs.) U.S. Launched 8/12/60, est. life 2-16 years. Orbits earth; perigee 934, apogee 994, period 117.0. First successful orbiting of passive communications satellite.

COURIER IB (500 lbs.) U.S. Launched 10/4/60, est. life 200-500 years. Orbits earth; perigee 604, apogee 750, period 106.9. First successful launching of delayed active repeater satellite. Transmitting.

★**EXPLORER VIII** (90 lbs.) U.S. Launched 11/3/60 by JUNO II, est. life 20-50 years. Orbits earth, perigee 262, apogee 1412, period 112.6. Provides ionospheric measurements for communications. Not transmitting.

★**TIROS II** (280 lbs.) U.S. Launched 11/23/60, est. life 200-500 years. Orbits earth; perigee 378, apogee 461, period 98.2. Transmitting.

★**SAMOS II** (4100 lbs.) U.S. Launched 1/31/61. Orbits earth; perigee 295, apogee 342, period 94.9. First R&D reconnaissance satellite.

★**VENUS PROBE** (1419 lbs.) Russia. Launched 2/12/61, aphelion 1.684 au, perihelion 0.7104 au.

★**EXPLORER IX** (15 lbs.) U.S. Launched 2/16/61. Orbits earth; perigee 430, apogee 1580, period 118.2 A 12-ft. "polka dot" balloon.

★**DISCOVERER XX** (2450 lbs.) U.S. Launched 2/17/61. Orbits earth; perigee 176, apogee 440, period 94.7. No attempt to recover 300-lb. capsule because of malfunction.

★**DISCOVERER XXI** (2100 lbs.) U.S. Launched 2/18/61. Orbits earth; perigee 154, apogee 572, period 96.6. Carried IR equipment for MIDAS program to measure background radiation from earth.

★**EXPLORER X** (78 lbs.) U.S. Launched 3/25/61. Last known position: perigee 110, apogee 112,500, period 5012. Optical-pumping magnetometer. Position uncertain.

★**DISCOVERER XXIII** (2100 lbs.) U.S. Launched 4/8/61. Orbits earth; perigee 183, apogee 372, period 93.6. Capsule ejected in wrong direction, sending it further into space. Transmitting.

★**EXPLORER XI** (82 lbs.) U.S. Launched 4/27/61. Orbits earth; perigee 302, apogee 1107, period 107.9. Measures gamma rays from the stars absorbed in earth's atmosphere.

★**DISCOVERER XXV** (2100 lbs.) U.S. Launched 6/16/61. Orbits earth; perigee 139, apogee 250, period 90.8. Carried rare and common metals to study effects of space on them.

(Orbital data is latest official information as of 1200 Z, June 20, 1961)

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(Continued from page 22)

were determined, said Campbell, it was only necessary to weight each parameter, plot it, and thus describe a conceptual approach to the necessary checkout system. Martin feels that the technique holds true for any given weapon/checkout situation.

With this approach, the extremes would then be (for checkout parameters): from manual to fully automatic, from special-purpose to multipurpose, and from completely decentralized to fully integrated subsystems.

• **Use of the Cube**—The study group first selected what it believed to be the most promising of conceptual checkout approaches from the Golden Cube. These were the integrated automatic and decentralized automatic concepts—with the manual concept added as a check on the group's method of performing the study.

Each of the three concepts was employed by each team to generate 27 detailed hardware designs. These provided a means for evaluation and a plan which permitted comparison of results on a reasonable basis.

For the detailed designs, the same approach used on a missile project was employed. A team would start with mission requirements, work upward to maintenance and philosophy, and finally culminate in a detailed statement of the checkout task.

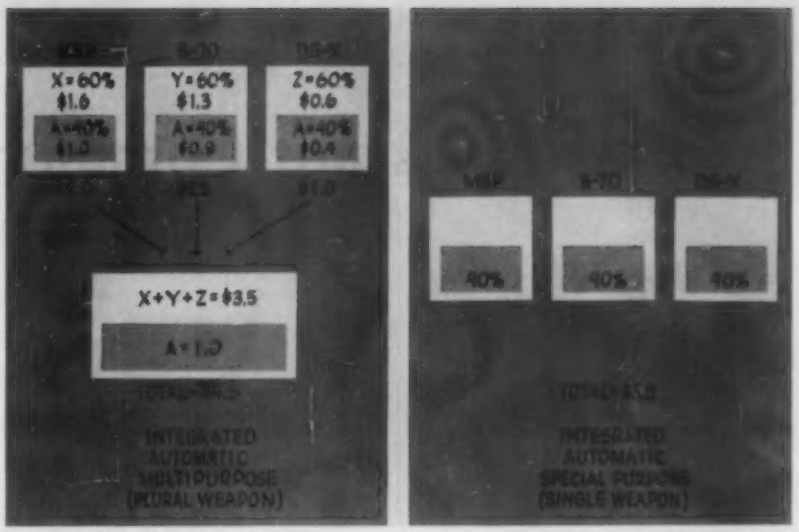
Checkout designs by each team were required to conform to four ground rules:

—To fulfill one of the three conceptual approaches;

—To perform the checkout properly;

—To be a reliable configuration; and

—To locate malfunctions to the level specified in each weapon-system maintenance philosophy.



COST COMPARISONS of multipurpose versus special-purpose integrated automatic checkout systems. Three hypothetical vehicles were considered: a manned space platform (MSP), a B-70 follow-on aircraft, and a Dyna-Soar follow-on (DS-X).

• **Degree of standardization**—In each case, the system configuration was left open as a degree of freedom. For example, there are 24 typical options in an integrated automatic system. It could have a computer and/or digital or analog blocks, multi- or special-purpose subsystems, single or multi-channel, and near or remote control ($3x2x2x2 = 24$ options).

Study results did indicate that standardization should be undertaken at the functional-chasis level. Also, additional provisional standards could be set for the module or printed-circuit-card levels if subjected to frequent updating.

The feasibility of standardizing major components was found to be 40% for digital and analog building blocks, but up to 70% for a computer-based approach. (Estimates were made by taking the ratio of versatile hardware to total hardware and averaging them over the various hardware designs.)

• **Universal checkout**—The true universal checkout system is at the integrated-automatic-multipurpose corner of Martin's Golden Cube. But the study indicated that it was doubtful whether the three co-relating weapon parameters would combine very often to require the concept.

The conditions necessary for a universal checker are a continuous, very high workload from diverse weapons randomly channeled through a single logistic area. Further, all such weapons must be completely integrated with respect to checkout.

To support its argument, the study group performed a cost comparison with three similar conceptual weapon systems—a manned space platform, a B-70 follow-on, and an advanced *Dyna-Soar*.

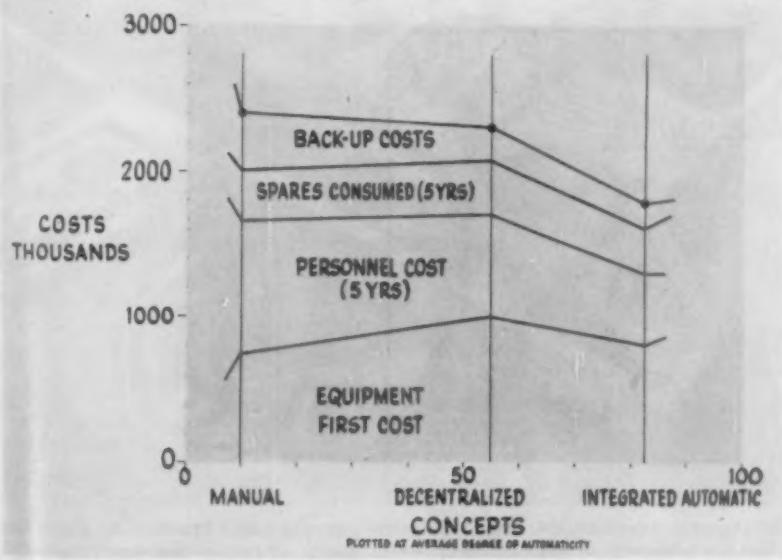
First, the researchers made the assumption that, although doubtful, it is conceivable that three such vehicles might be serviced in the same high-workload logistic area.

The universal checker next created was one provided with one versatile core (A) and three special-purpose sections (X, Y, and Z).

Each of the three automatic integrated checkout systems had one versatile core representing 40% of the hardware and cost.

Total cost of the universal checkout system capable of serving three weapons systems was $4.5 million. Cost of the three individual special-purpose units

(Continued on page 42)



Average Costs of Concepts

Blast-Resistant Communications Guard

Collins-developed system at SAC's Fairchild base takes over-pressure shock waves up to 25 psi; even antennas have heavy protection

A "TOUGHENED" microwave communication system—reportedly the first ever built—has been installed at the *Atlas* missile base at Fairchild AFB, Spokane, Wash.

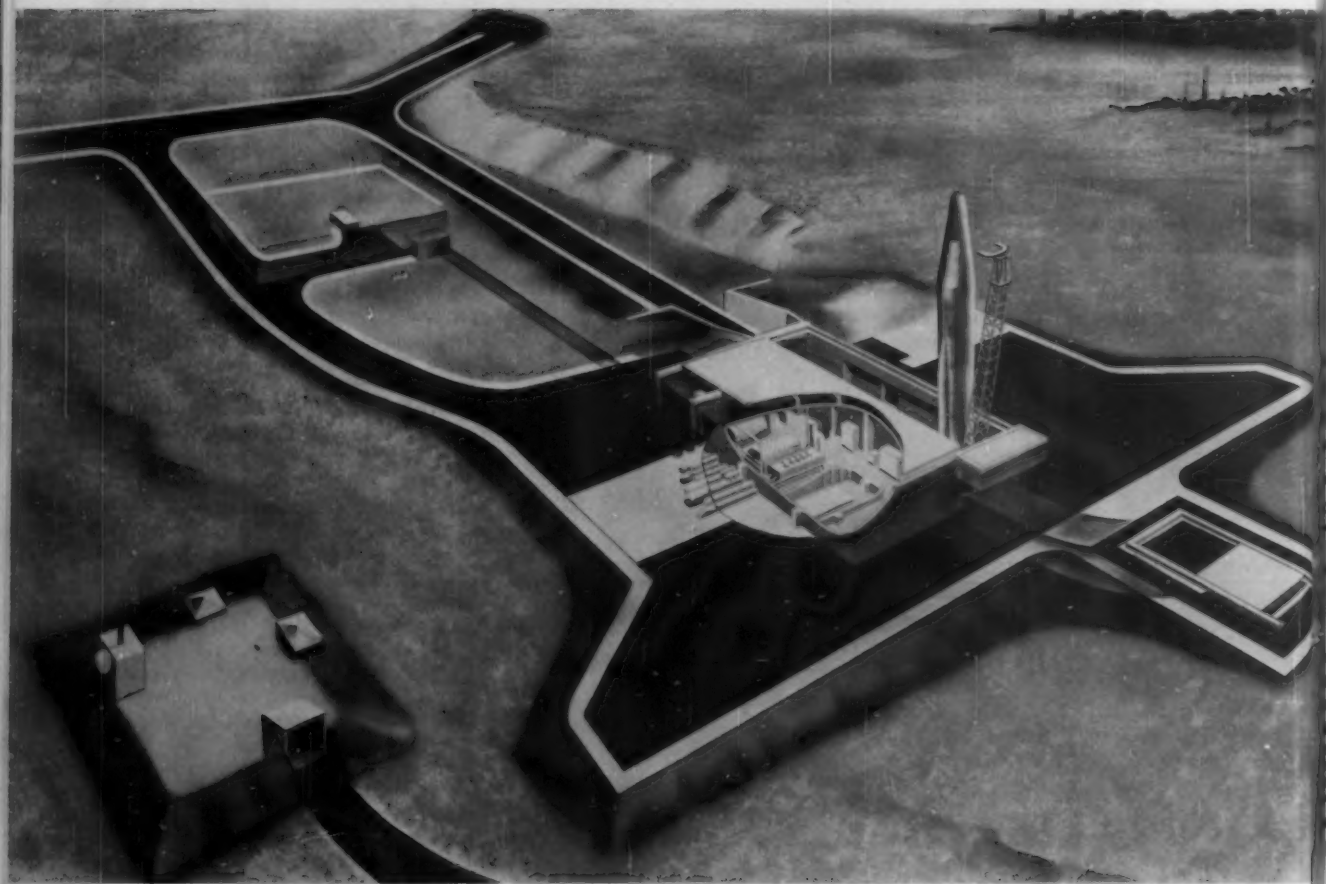
Protection from over-pressure ground shock waves up to 25 psi and automatic fault-sensing and reroute switching are the most novel features of the system, developed by Collins Radio Co.

Equipment racks at each launch site are installed on specially designed shockmounts 20 feet underground in concrete and steel bunkers. Four-foot antennas used for most terminals are mounted in concrete pedestals and protected by high-strength plastic radomes.

The system can provide a total of 480 3-kc voice channels to serve the widely dispersed launch sites and the command post control center.

A total of 862 channel ends are currently being used for channels carrying the various command and control circuits. The system can be expanded to 600 voice channels. Fault-alarm and automatic switching circuits are provided exclusive of the voice multiplex.

Basic system design includes three loops. One provides primary and alternate routing for communication between the control center and a number of the *Atlas* launch sites, as well as additional drops at each site for intersite communication. Another loop handles the various additional launch sites in the same manner.



TOUGHENED COMMUNICATION SYSTEM connects Atlas launching sites with control center at SAC's Fairchild Air Force Base near Spokane, Washington. The system is designed to withstand all but near-direct nuclear blasts; all components with exception of antennas (at lower left) are housed in underground concrete bunkers.

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Atlas Base

An interconnect loop supplies primary and alternate circuits between the other loops and make available a small number of highly reliable circuits between all points of the system, originating either from Fairchild or other locations.

Communication functions within the primary loops are completely isolated by the use of dual r-f paths from the control center to adjacent repeaters. Baseband low- and high-pass filters are incorporated at these two repeaters through the interconnect loop to provide the required channels between the two basic loops.

Frequency-diversity operation is employed throughout the system, using combining techniques to yield a signal equal to or better than the best received path. R-f transmitters and receivers are stackable, making it possible to use a common waveguide and antenna system without resort to circulators.

Since simultaneous fading on such widely spaced frequencies is extremely unlikely, the system provides the reliability called for by SAC requirements.

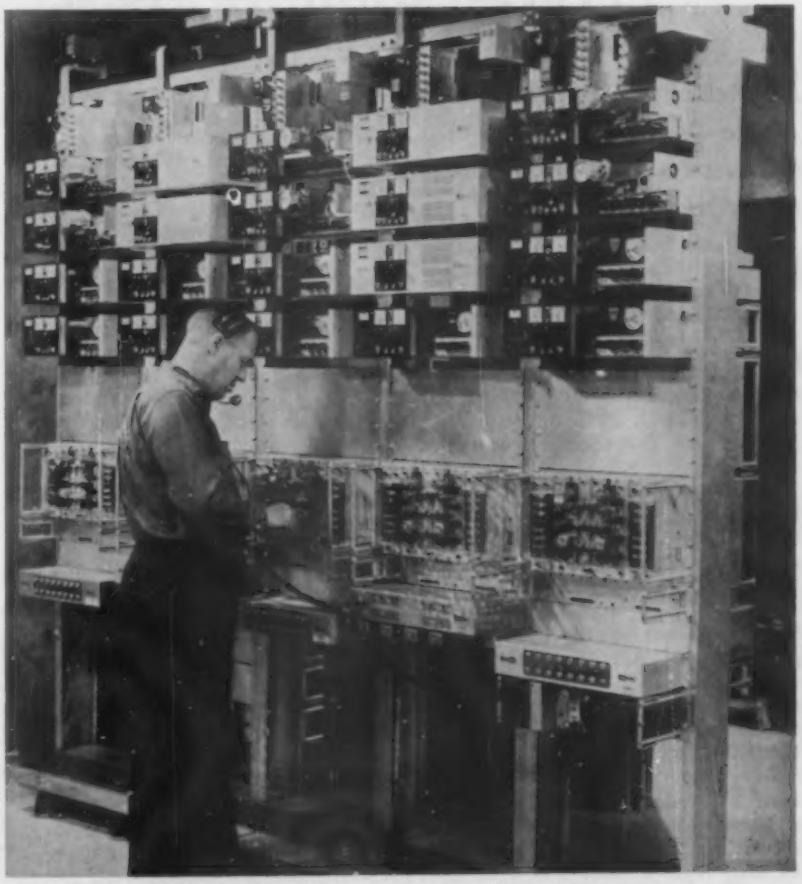
• **In emergencies**—A float-charged battery system is used for all installations. This provides 24, 48 and 130 volts for operation of d-c microwave, carrier, and signaling equipment without the use of rotary converters. The system can operate for as long as eight hours on battery power, in case of a failure of the primary power.

In event of any interruption to the normal circuit routing, the energized sensing circuits perform a dual function: activating baseband switching to reroute the channels, and activating visual and audible fault alarms at the control center.

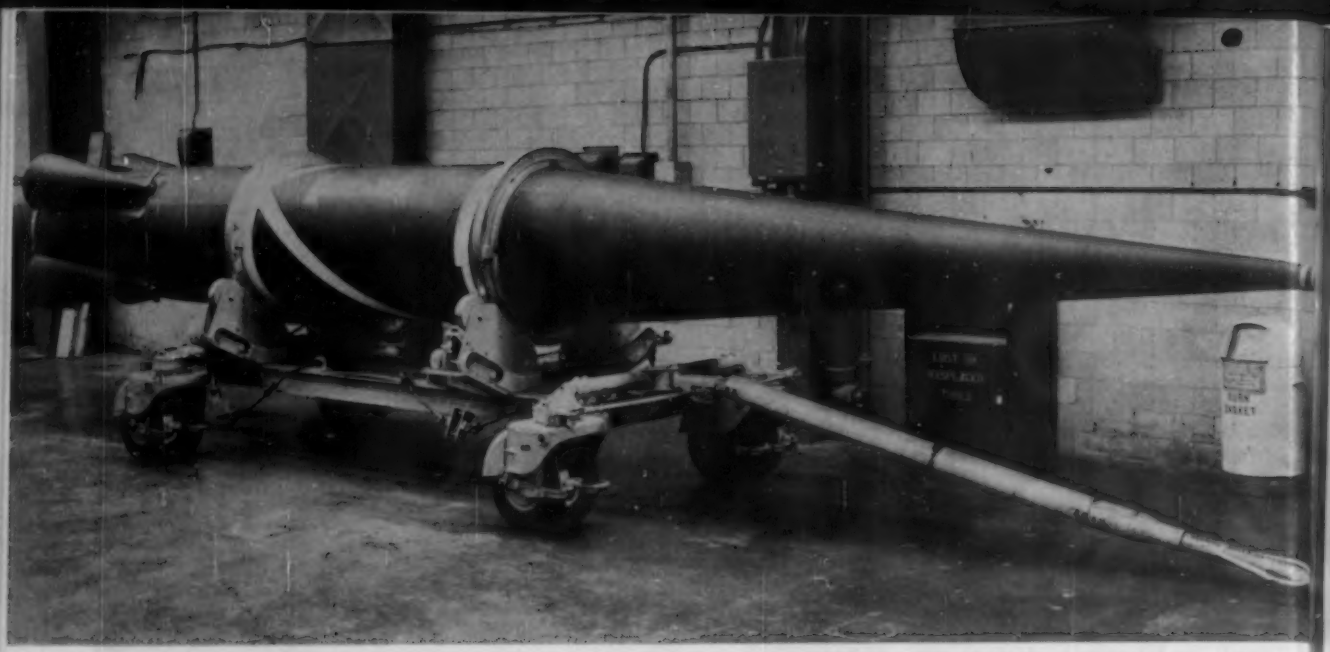
The switching circuitry reroutes the inoperative channels within 50 milliseconds, allowing continued channel operation in a reverse direction, bypassing the affected terminal.

The fault alarm system detects six individual functions from each of the terminals and reports them to the control center. These are diversity path alarm, carrier common equipment switchover, r-f and carrier fuse alarm, unauthorized building entry, battery charger failure, and alternate routing monitor. ⁂

RADOMES of high-strength plastic nearly inch-thick, on heavy concrete pedestals, protect 4-ft. microwave antennas, only above-ground components of system.



EQUIPMENT RACKS in underground bunkers, including this five-way junction repeater, are shock-mounted to withstand shock and vibration pattern created by over-pressures of up to 25 psi, and designed for unattended operation.



ALPHA-DRACO vehicle minus first stage or booster.

R&D vehicles

Hypersonic Boost-Glide Tests Point

AF-McDonnell program using Alpha-Draco vehicle seems to indicate great potential—NACA drawing recalled

by John W. Herrick

BALLISTIC MISSILE range has been increased without raising propulsion requirements in the $5.5-million Air Force/McDonnell Aircraft Corp. program on hypersonic boost-glide vehicles.

Successful flight tests and wind tunnel studies also indicate that ballistic missile payloads can be increased through the same technique.

The McDonnell program involved the Alpha-Draco Hypersonic Research Vehicle, known in the work's early phases simply as an aeroballistic Research Vehicle.

First Alpha-Draco vehicle to be test-flown was propelled to Mach 5.0 at 100,000-ft. by integral solid-propellant rocket motor after a first-stage boost from an *Honest John* launcher by another solid propellant unit.

The McDonnell-designed and -manufactured flight control system directed the vehicle into a flat glide path after propulsion stopped, and vehicle range was stretched out beyond that of a pure ballistic trajectory by a still-classified percentage figure.

The vehicle maintained level flight on body lift alone. Wings would not improve performance, McDonnell engineers said, because of added weight, increased drag and heating.

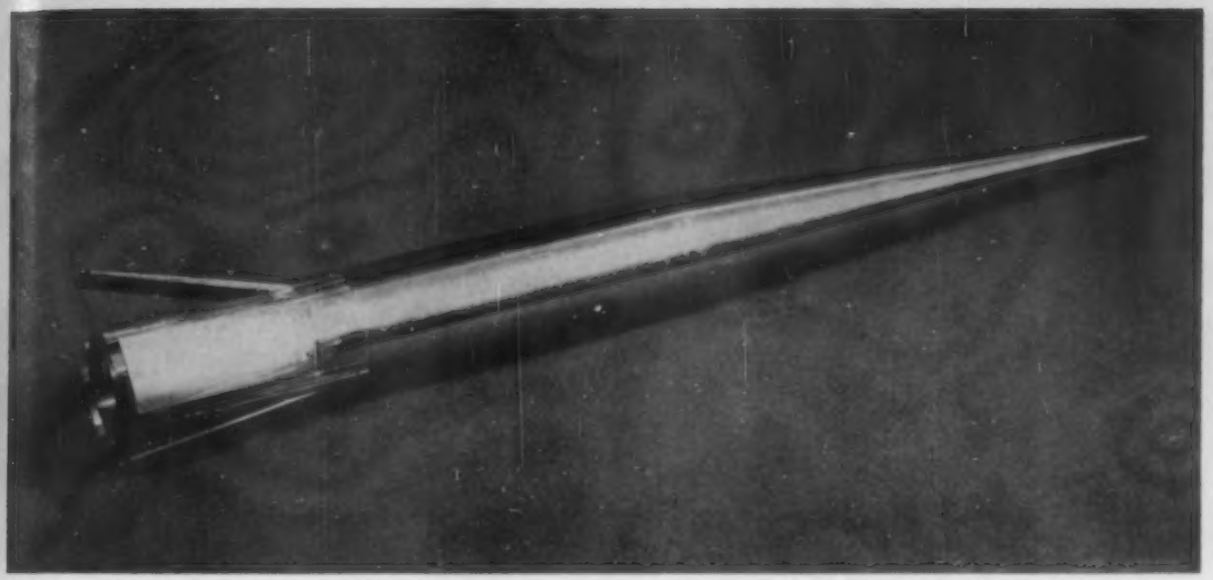
A ballistic dive was obtained at glide trajectory termination by trimming the stabilizers at zero angle of attack. During the dive to impact point, the stabilizers continued to correct the trajectory to compensate for wind shear and other perturbations.

The Alpha-Draco vehicle stayed within maximum permissible temperature limits, McDonnell's Missile Engineering Division says. The simple high-fineness-ratio symmetrical shape presented the advantage of minimum surface area for maximum volume. Reradiation and internal insulation protected internal components from heat transferred through the skin. Heat produced by power system components was removed by an internal cooling system.

One distinctive feature of the Alpha-Draco is the method employed to limit the effects of severe aerodynamic heating. A slow roll while in gliding flight eliminates localized heating and thermal warping by distributing the absorbed heat evenly over the skin and structure. The four aft bulk control surfaces control the roll rate as well as yaw angle and angle of attack. The cone-tipped cylindrical body is kept at the angle which gives the maximum lift/drag ratio.

The Alpha-Draco vehicle, also known as 122B, would appear to have definite research applications. Some possible uses outlined by McDonnell include:

- **Propagation research**—This effort would consist of studying characteristics of electromagnetic transmission through an ionized layer at Mach 8 or March 12. The 122B would be equipped with suitable transmitters and/or receivers to cover the band of frequencies and power levels. Signal deterioration would be measured by monitoring phase shift of the transmission.
- **Radar reflectivity characteristics**—An effort to determine the amount of radar reflectivity enhancement due to an ionized layer around a hypersonic body and following the body in flight.
- **Infrared radiation spectrum radar studies**—Primarily a passive effort in which ground tracking stations would track and define radiation spectrum of the missile.
- **Antennas**—Such materials as quartz-loaded teflon and pyroceram would be made into a variety of antenna configurations and examined at high speed for durability, electrical and thermal characteristics.
- **Range calibration**—The vehicle would replace present methods of At-



WIND-TUNNEL MODEL was tested at Mach 8.0.

nto Longer Range, Bigger Payload

lantic Missile Range calibration in which a subsonic aircraft is flown down range at relatively low altitudes. Use of Alpha-Draco would permit extension of calibration under higher speed and altitude regimes. Measurements of field strength from range radar and command transmitters would also be possible.

The vehicle could also be used for studies of structural temperatures by mounting small bodies on the 122B and instrumenting the bodies for loads, flutter and temperature. Ablation and transpiration studies could also be made.

Still other possibilities include use of the vehicle for surveillance studies, horizontal upper air measurements (wind shear, meteoric impact and atmospheric composition) and as a flying wind tunnel with scale models mounted on the vehicle's front end with measurements for lift and drag taken under a variety of attack and yaw angles.

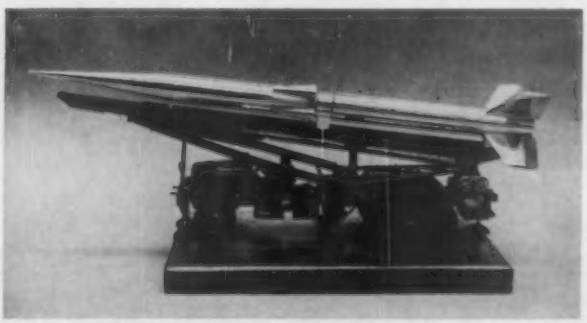
Much of the thinking behind McDonnell's project is based on a concept proposed by Dr. Alfred Eggers, Jr., H. J. Allen and Stanford Neice in NACA (now NASA) report 4046, "A Comparative Analysis of the Performance of Long-Range Hypervelocity Vehicles." There is little visible difference between the Alpha-Draco and the original NACA drawing.

As pointed out by Eggers et. al., "The glide vehicle with L/D ratios of approximately four is far superior to the ballistic vehicle in ability to convert velocity to range . . . on basis of equal ratios of mass at takeoff to mass at end of propelled flight, the hypervelocity vehicle compares favorably with the supersonic airplane for ranges of one-half the circumference of the earth."

The NACA report offers a few more observations on potentials of the hypersonic glide concept.

The authors claim that the gliding bodies will be difficult to defend against, as well as being more efficient than ballistic vehicles. The report also claims that the glide vehicle is superior to the skip vehicle which experiences extremely large loads and severe aerodynamic heating.

McDonnell sources, however, decline to describe any specific applications of Alpha-Draco to obvious improvements in ballistic weapons, using the increased range capability to carry nuclear devices to targets now inaccessible or to confuse enemy countermeasures (anti-nosecone) system by not re-entering on a Keplerian trojectory. ⠿



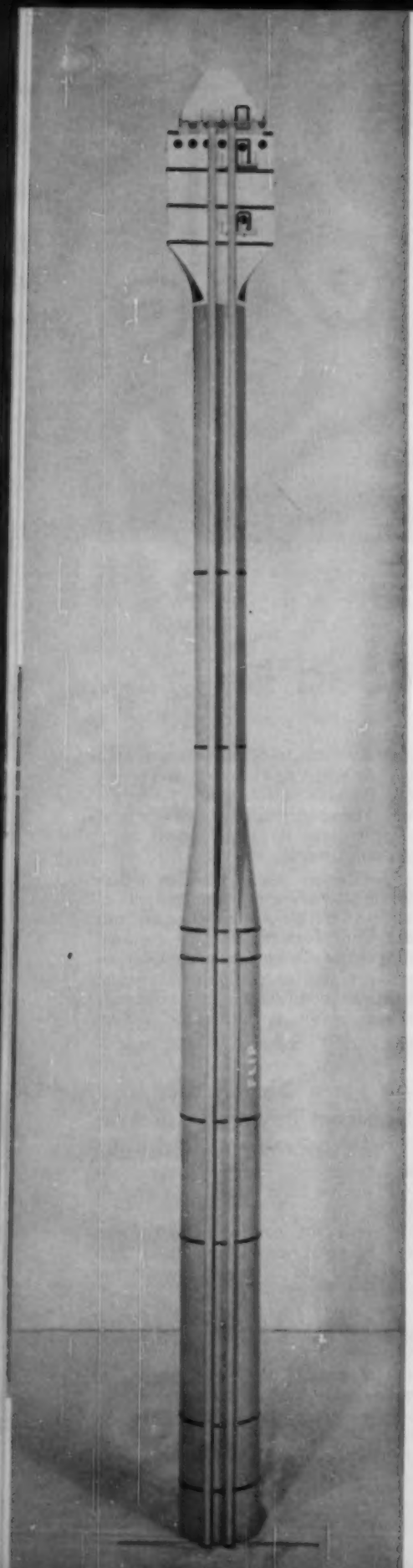
ALPHA-DRACO MODEL shown on toy Army launcher. First vehicle flown was given first-stage boost from Honest John.

Air Force Consolidates Its Hanscom Buying Operation

THE AIR FORCE has consolidated its contract and procurement operations at Hanscom Field, Mass., into a single office.

Previously, contractors dealt with the Research and Development Procurement and Systems Procurement Offices.

Consolidation is expected to result in better control of the buying activity by the Air Force, and to make it easier for contractors and representatives to reach their contact. Because of the simpler procedures involved, the Air Force feels the new setup will have special appeal to small businesses interested in AF contracts. ⠿



ASW engineering

Weird 'Flip' Vessel De

Research ship, longer than football field, will go to sea in horizontal position, switch to vertical to provide highly stable platform for submarine equipment

by Bill Wilks

LA JOLLA, CALIF.—A research vessel with a 30-story-deep tubular hull is under development by the Office of Naval Research and the Marine Physical Laboratory of Scripps Institution of Oceanography.

Designed primarily in hopes of making a breakthrough in underwater submarine detection, the unique craft, 355 ft. from top to bottom, is dubbed "Flip"—short for Floating Instrument Platform. It will be towed to sea in a horizontal position and then literally flip to the vertical by ballasting its aft section with sea water, leaving only its four-story—55 ft.—bow above water.

A construction contract for the vessel, to be funded by the Navy, will be awarded soon following formal approval by regents of the University of California, which operates MPL for the Navy. The cost will run from $450,000 to $475,000.

In operation, Flip will carry four oceanographers and be allowed to drift with ocean currents and winds, controlling its draft by varying tank ballast. While floating on station it will be able to rotate about its vertical axis by means of two marine engines. It will have no other propulsion. A mother ship will attend Flip, although the crew could carry supplies to operate for up to two weeks. There are no plans to anchor it at sea.

Jeff Frautschy, assistant director of Scripps Institution, said Flip was expected to provide "a very stable platform that can carry experimental equipment below the thermocline, the water layer about 150 ft. down where a marked temperature drop begins."

Major reason for wanting to get below this level is "so we can experiment with some submarine equipment without having to use a sub," Frautschy said. The thermocline can shield a submarine from sonar detection.

"We need a very stable platform for a variety of reasons," Frautschy added. "For one thing, it will minimize hydrophone noise since motion relative to the water will be quite small."

Flips' first story, normally riding about 20 ft. above the water, will house two diesel engines and generators producing 120 kilowatts; the second story will provide living quarters; the third will house an electronics laboratory; and the top story will be a "wet lab" containing winches and other equipment. Each deck will have about 312 sq. ft. of floor area.

The crew will be able to descend dry through the tube to 150 ft. below water level, where observation ports may be installed.

Experimental gear and instruments will be lowered through two 2-ft. diameter pipes running top to bottom outside Flip's steel hull. Research work will include taking drill samplings from the ocean floor. An outside rail-mounted platform may be installed next to the pipes.

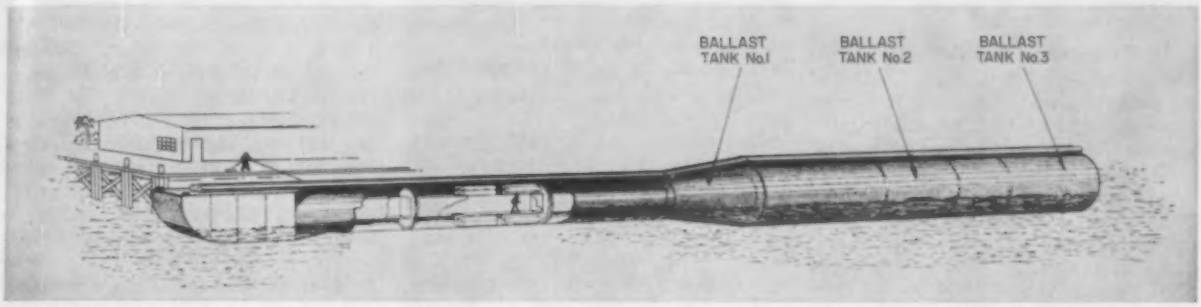
Immediately below the bow, Flip narrows to a tubular section 12½ ft. in diameter and 165 ft. long. The lower portion, including a "hard" ballast tank reinforced to withstand full pressure differential at that depth, and two nonpressurized tanks, is 20 ft. in diameter and 135 ft. long.

The vessel's simple ballasting controls are accessible in either position, while other controls are designed for vertical operation. The two powerplants are trunion-mounted for operation in either position.

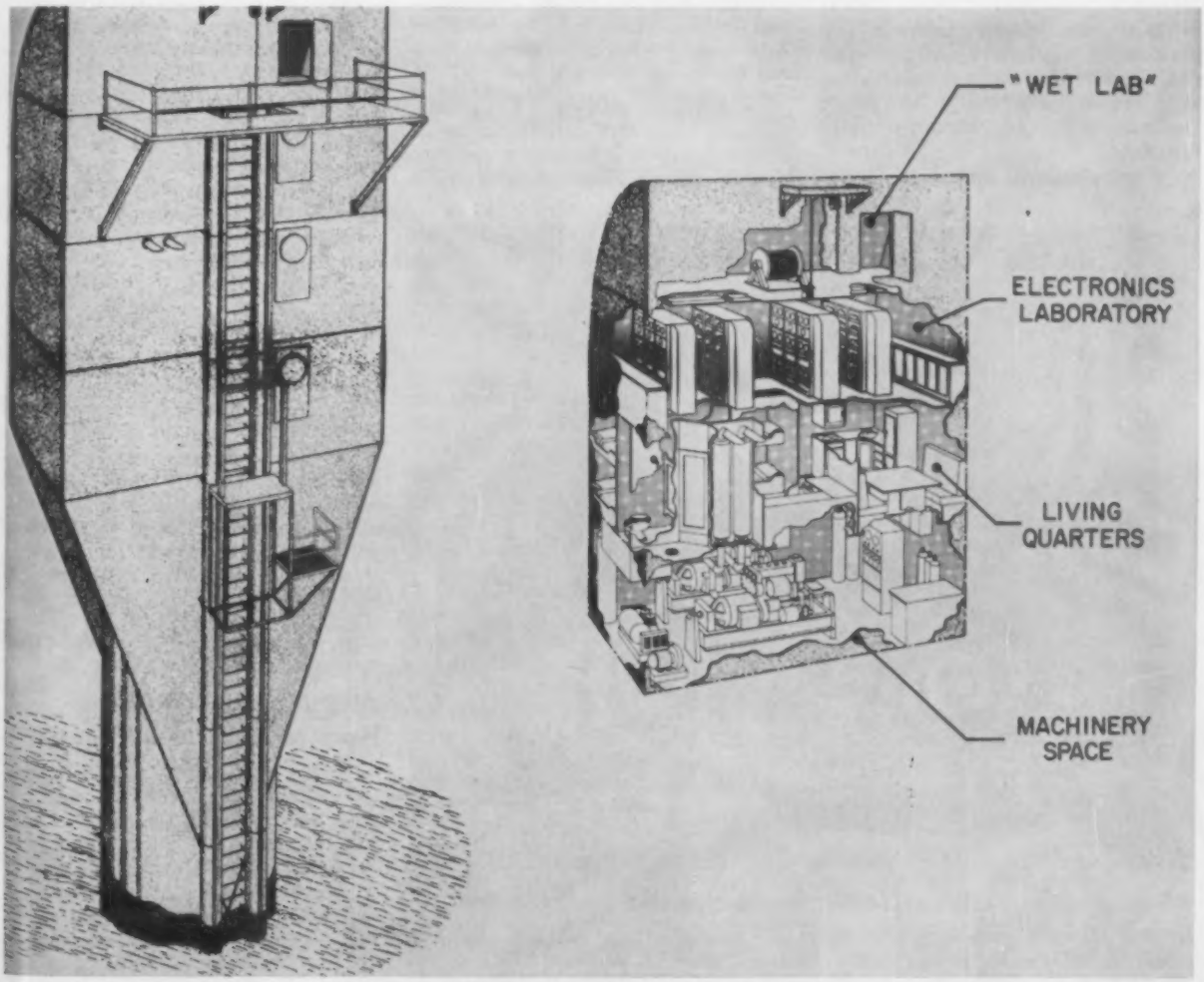
Because of its inherent stability, Flip should be able to "ride out a good-sized storm," Frautschy said. ⌗

CALLED the "ultimate vessel in oceanographic research," Flip—Floating Instrument Platform—will seek a Navy breakthrough in underwater detection of submarines.

Designed to Yield Breakthroughs



NEW 355-FT. FLOATING LAB will be towed to sea in a horizontal position, then flipped to vertical position, by ballasting tanks with sea water, so that all but upper 55 ft. of the vessel will be submerged.



UNIQUE RESEARCH SHIP, rearing from the sea like a giant periscope head, will drift with currents while its crew of four oceanographers carries out experiments. Crew will carry supplies for as long as two weeks.

Communication Satellites...

(Continued from page 11)

It was unofficially reported last week that the Space Council would meet shortly to discuss the staff reports on the study. There has been no definite statement as to when the study will be completed, but estimates run from one to several weeks.

• **Compromise at hand**—The study has apparently set back an FCC decision on ownership of the system. Although this was denied by FCC officials, a commission meeting on the problem scheduled for last week was not held.

As the study opened, commission officials declared that they and the Justice Department are not far apart on a compromise to settle the anti-trust question. Commissioner T. A. M. Craven said that a provision requiring any commercial enterprise operating the system to "call for competitive bidding on all procurement" might go a long way to settle the thorny issue.

It is quite possible, however, that the Council will recommend that other firms besides international communications carriers be allowed to join in the ownership of the commercially operated systems.

• **RCA stresses R&D**—One industry view was revealed by David Sarnoff, board chairman of Radio Corporation of America, who told a National Press Club audience that "the much-debated question of satellite ownership is, in my opinion, far less important at this time than the adoption of the right system at the earliest possible moment.

"To expedite the achievements possible in this area, we at RCA feel the time is ripe for the formation of a joint government-industry group to pursue an aggressive total effort in research and development.

"Through this collaborative effort, we can agree on the best satellite communications system. We can get it in operational orbit in the shortest time, and we can share with the world a remarkable technique for nation-to-nation seeing and talking," Sarnoff declared.

Two of the principal firms involved in presenting plans for the commercial satellite system have been the American Telephone and Telegraph Co. and General Electric.

• **A.T.&T.'s plan**—A.T.&T. initially plans to place 30 satellites in about 6000-mile orbits. It is thought that even if these orbits are random and uncontrolled, at least one will be visible both in the U.S. and Western Europe except for a period of less than two minutes a day. In a different part of the orbit, the 30 satellites can also provide service between the U.S. mainland and Hawaii.

The A.T.&T. plan also calls for satellites with repeaters to handle four broadband two-way radio channels. Each channel could carry 600 telephone signals or one broadcast-quality television signal. The firm estimates that by 1980, it will need 12 broadband two-way channels between the U.S. and Western Europe, including Britain.

Thus, by that year, 50 orbiting satellites will be needed to insure the probability that four satellites would be visible to the U.S. and European countries.

A.T.&T. has been authorized to use frequencies in the 4000 megacycle range for an experimental system.

It claims that it has made considerable progress on the development of such a system and that at 4000 megacycles there is a loss of 185 db between an isotropic antenna on the ground and another one 6000 miles in space.

Through the use of a 60-by-60-ft. horn antenna, the firm says, it can get a gain of 57 db.

To permit launching with contemporary rockets it is thought that a satellite should weigh about 100 lbs. With a 27-in. satellite, 3528 solar cells will be distributed over 55% of the satellite's surface. These will operate a two-watt traveling wave tube and associated circuitry as power amplifiers.

• **G.E.'s challenge**—GE, through Communications Satellites Inc., is challenging almost every aspect of the A.T.&T. plan. The GE plan would involve 10 satellites in equatorial orbit—much like the *Advent* system which it is helping to build for the Army.

It claims that the equatorial approach is required to realize the full potential of international message traffic, since it would cover most of the globe's populated regions. It also contends that an equatorial system would require only 10 ground stations, while a polar system would require many more to provide multi-directional service. ¤

Wee Un-timorous Beastie

MOUSE IS STILL quite frisky after an 80-hour stint in a closed cell with potassium-superoxide regenerating oxygen supply. Lockheed Missiles and Space Company test showed that an amount of the oxygen-regenerating chemical weighing as much as the mouse itself was used up every 20 hours. Excess oxygen produced by the highly active chemical was bled off by a specially designed regulator.

ARS Members to Play Host to IAC Delegates

FOREIGN DELEGATES attending the International Astronautical Congress in Washington this fall will have a good chance to communicate with American scientists and engineers.

Members of the Washington Capital Section of the ARS, hosts to the IAC, are inviting visiting delegates to be their houseguests while in Washington.

The XIIth IAC will convene Oct. 2 through 7. ¤

AF Probe Finds Heavy 'Dust' Band

AN AIR FORCE experiment has confirmed that a dense band of micrometeorites envelopes the earth at high altitudes.

Spokesmen for the Cambridge Research Laboratories, which directed the tests, said the density of the micrometeorites was totally unexpected, although the existence of the layer has been suspected for some time.

The band was discovered by an ingenious device carried in the nose cone of an *Aerobee-Hi* rocket launched from White Sands, N.M., June 6. Further tests were made June 23 by a *Nike-Cajun* research rocket launched from the Air Proving Ground Center at Eglin AFB, Fla., results of which have not been disclosed.

The *Aerobee-Hi* rocket carried a particle-trapping device which operated much like a Venus flytrap plant. It opened at an altitude of 47 miles and closed at 65 miles. Time of exposure was about four minutes.

The nose cone carried two types of micrometeorite detectors. On the "leaves" of the device were triple-layer sheets of mylar and plexiglass. Micrometeorites traveling faster than 47 mps passed through the two top layers (¼-mil and 1-mil-thick Mylar) and created craters in the harder, ⅛-in.-thick plexiglass bottom layer.

A few craters also were found in the second group of detectors, which were thicker films of Millipore, Formvar and Lucite plastics.

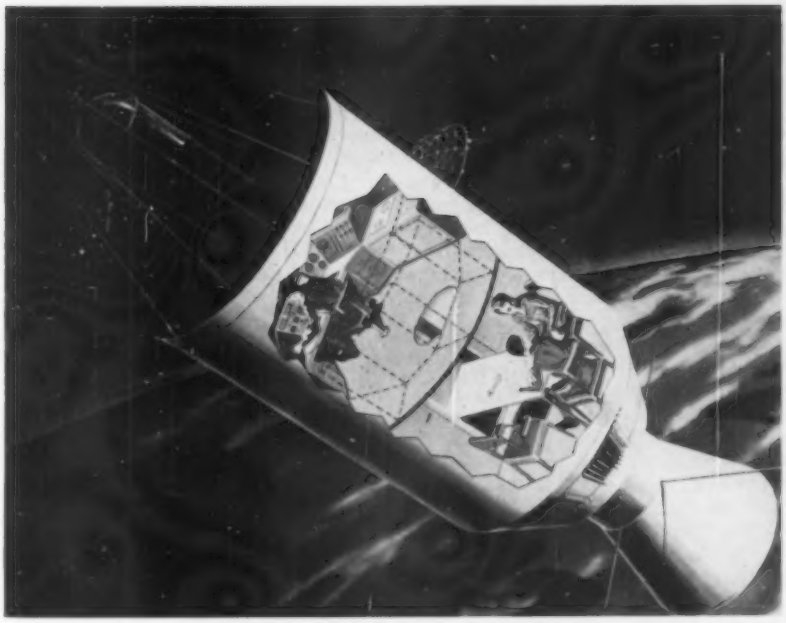
Only a few micrometeorites actually were collected, since for the most part they vaporized on contact. However, residual amounts of the material were found lining the walls of the craters.

Most of the analysis of the films will be done by electron microscopy techniques, since many of the individual particles are smaller than the wave length of light.

AFCRL said that a large number of samples would be furnished to interested, qualified scientists for analysis.

Dr. Robert K. Soberman of CRL has theorized that the layer is formed by electrostatic trapping.

Thomas G. Ryan of AFCRL supervised the recent tests. Assistance was provided by Aerojet-General, Fullam Laboratories and Dudley Observatory in Albany, N.Y. for the *Aerobee-Hi* test. Test package for the *Nike-Cajun* rocket was prepared by Temple University, Philadelphia. ⌗



Proposed Three-man Station

GENERAL DYNAMICS/ASTRONAUTICS artist's conception of the division's proposed three-man Manned Astronautical Research Station (MARS) in operation in an orbit 200 miles above earth. The station in orbit would be linked to a spent Centaur rocket vehicle. The two bodies would rotate about each other, the resulting centrifugal force providing the necessary artificial gravity.

Taped System Slashes Inspection Time

PRECISION missile parts can be automatically inspected with a new, highly accurate tape-controlled measurement system developed by Sheffield Corp., a Bendix subsidiary.

The 16-ton system can complete almost 1000 precise measurements in two hours—a job requiring up to 125 hours by any other method. In addition, Sheffield says, the system is much more accurate than other techniques. The gaging machine is so sensitive it can automatically detect a deviation as small as 0.00001 in. from specified dimensions.

The part to be measured, for example a missile nose cone, is mounted on a rotary base plate. Electronic "fingers", or gages, "feel" the inner and outer surfaces of the part. Signals from these sensors are automatically converted to extremely accurate measurements of contours and thickness.

The part's nominal dimensions, encoded in serial form on punched tape, are used as command signals for positioning the workpiece slide and the vertical slides carrying the gage cartridges. With the gages positioned for a given horizontal plane, the part is rotated about its vertical axis, either in controlled steps or continuously.

Deviations from the nominal dimensions are printed out in tabular form as well as visually indicated for various points on the plans. The number of planes as well as the number of points of inspection depend upon the part specifications. For a part such as the transparent hemisphere shown in the photos, a point of inspection might be specified at every two degrees latitude and every 60 degrees longitude for outside contour, inside contour, and wall thickness. Such a program would require a total of 795 gage readings, including 265 mathematical computations for wall thickness. Total time for the inspection and data printout would be approximately two hours.

The machine is programed from the part's design specifications. The gage programer prepares a process sheet listing the X and Y positions of all the gage points on the parts to be inspected. This data is fed into a Flexowriter that produces a standard 8-channel code-punched tape.

The Bendix DynaPoint numerical control unit reads and executes each command as it appears on the tape. The command may be to move a slide a specific distance, rotate the table, or to perform auxiliary functions.

With sensors in gaging positions, the tape also initiates the gage readout cycle. Deviations from nominal size detected by the gages are fed into the analog-to-digital convertor, and the data is printed out in tabular form. ⌗

Souped-up Thor

(Continued from page 13)

has not been changed to any great extent, about 1180 lbs. has been trimmed from the booster.

Current *Thor* production follows a standard design in the upper-stage transition section, which is then fitted according to the vehicle's intended payload. Three regular transition sections are now in production on a separate line at Douglas: *Discoverer (Agena B), Transit (Ablestar)* and *Delta*, which has two upper stages.

Delta uses the operational-missile transition section with necessary modifications to accept the Aerojet-General second stage. The Allegany Ballistics Laboratory third stage is then added. Both the *Transit* and *Discoverer* stages require special transition sections, and the former is further modified by the inclusion of exhaust ports and guide rails.

The exhaust ports consist of two door openings and two rows of holes covered by a two-foot-wide steel band. The *Transit* second-stage engine is ignited after mainstage burnout but before separation, and while the *Thor* vernier engines are still burning.

The port-covering band is then blown off by explosive bolts, almost simultaneously with stage separation action.

Approximately this same technique is used to separate upper stages of the *Delta* booster. Exhaust gases from the upper-stage engine are vented through the 24 six-inch ports located in a ring around the base of the transition section. A blast band, also used to cover these ports, is detached with explosive bolts at second-stage ignition.

Panel fairings give additional venting area. They are peeled back by spring-loaded actuators at ignition.

Discoverer payloads using Lockheed's *Agena B* are separated by retro rockets, and the *Agena B* engine—a Bell Hustler—is ignited only after a variable coast period has passed. The vehicle has both zero-g and space restart capabilities.

A flight controller has thus far been used in all *Discoverer* firings to guide the vehicle along a programed trajectory until booster burnout. The Air Force now plans to greatly improve final booster-positioning accuracy by limiting programed flight to about the first 90 seconds. Ground control will then take over, using Bell Telephone Labs' radio guidance system, and precisely position the booster until burnout.

The solid-state BTL guidance system reportedly "threads the eye of the needle" to greatly reduce corrections ordinarily made by the upper stage. Booster velocity, angle and attitude are monitored closely before burnout, so that the *Agena B* is at optimum position for the intended orbit.

• **Thor performance record**—Douglas considers itself akin to the father whose son has hit the winning home run.

From the date of the first *Thor* launch in January, 1957, the booster has had 117 launchings. Of these, it has performed its mission successfully in 43 of 51 space-mission launches, including 36 scientific space projects and seven re-entry test vehicle firings for nose cone R&D. Additionally, there have been 49 research and development firings of the vehicle itself, and 17 training shots by USAF and RAF.

Future assignments for *Thor* will include further *Discoverer, Delta* and *Transit* satellites, as well as *Nimbus, POGO* and other payloads. ¤

Automatic Checkout

(Continued from page 31)

was $5.8 million.

But the fallacy in these figures, Martin believes, is that three low-workload logistic areas are much more likely to be used than is a single high-workload area. Thus, if a universal checker were to be employed, three such systems would be needed—at a cost of $13.5 million, well over twice the cost of three special-purpose systems.

The study report indicated that the individual unit would be significantly more effective from all points of view. Also, the common versatile core employed by each could be drawn from an appropriate stockpile, and hence effect considerable dollar savings.

• **Average costs**—In an across-the-board survey of costs, Campbell's group plotted average costs of performing checkout tasks by each concept for all of the various weapon systems.

Costs were broken down this way:

—Equipment—initial expense based on one system of a production quantity.

—Personnel cost over a five-year period. This included training, salaries, etc., for a full complement of checkout personnel.

—Spare parts, including those consumed and stocked during a five-year period.

—Back-up costs. These covered all logistic and overhead factors, including weapon in-service rates. These costs, said Campbell, were distributed among each of the checkout concepts at the rate of $1000/minute of checkout time.

The integrated automatic system approach proved to be somewhat cheaper than the decentralized semiautomatic concepts, and well under the manual concept. Personnel requirements appear to make the greatest difference in cost between integrated vs. decentralized concepts, Martin said, but it believes both will be required.

• **Future trends**—Checkout of future space vehicles will be based on an expected reasonable workload consisting of a number of planned subsystem changes. The vehicles themselves, said Martin, will fall into both decentralized and integrated checkout categories.

As these vehicles follow a normal evolution, checkout requirements will gradually include a higher workload, with a progressively lower number of planned modifications.

The degree of weapon integration will tend to increase, Martin believes, and checkout equipment will tend to change accordingly. This means that the initial design of checkout systems should be reasonably automatic and multipurpose.

Checkout for later phases of these programs will require equipment more highly automatized and more nearly special-purpose. ¤

Defense Dollars

(Continued from page 10)

and would require almost as much energy to change orbits as it needs to get into orbit. This deficiency may be overcome with on-board propulsion in a glider weighing 20,000 lbs. or more, compared with the present configuration's 10,000 lbs.

The committee ticked off several other areas of disagreement with DOD:

• **Polaris**—It said there should be provision for long leadtime items beyond the 29th boat, where the Administration has decided, for the present, to stop. McNamara said he was "delighted" the committee would entertain a request for reprograming of funds, but indicated no change in position.

• **Railroad Minuteman**—It has "reservations," the committee said, over the decision to slow up development of a mobile *Minuteman* system. McNamara, who has relegated this project to the back-burner of R&D, replied that *Polaris* was an "effective substitute" and it would be a "serious error" to risk the fixed-base program while accelerating the mobile.

• **Aerospace Corp.**—In chopping $5 million from the $35.2 million requested for the Air Force's non-profit management firm, the committee charged Aerospace Corp. salaries were "excessive," its overhead costs were too high and "it plans to employ too large a staff." But McNamara said he saw no difference between Aerospace Corp.'s president receiving $75,000 a year (it handles $35 million in contracts) and the president of a large defense contracting company who receives $125,000 "doing the same work." ¤

Vega Might be Antiaircraft Weapon

by Bernard Poirier

NORD AVIATION'S *Vega* research vehicle may have potential as a Mach 4 or 5 antiaircraft missile.

First released details of Sahara desert tests have shown that the 32.5-ft. *Vega* maintains marked capabilities at angles of incidence. A Nord spokesman says the vehicle's adaptability to widely varying flight conditions, together with its load factor characteristics in pitch and other capabilities, makes it highly promising for many uses. It could be a highly efficient vehicle for solving aeronautical control problems.

Its solid booster is 12 ft. 5 in. long, with a 22 in. OD and 11 ft. 8 in. wing span. Impulse varies between 120 and 130 tons/sec., depending on grain length. Short grain length weight is 2340 lbs., with burning time just shy of 5 secs.

The sustainer is a canard-configuration ramjet 19 ft. 3 in. long, with a 25 in. OD and 6 ft. 3 in. wing span. Fueled weight of the experimental version is 1430 lbs.; it carries a 31.7-gallon kerosene supply.

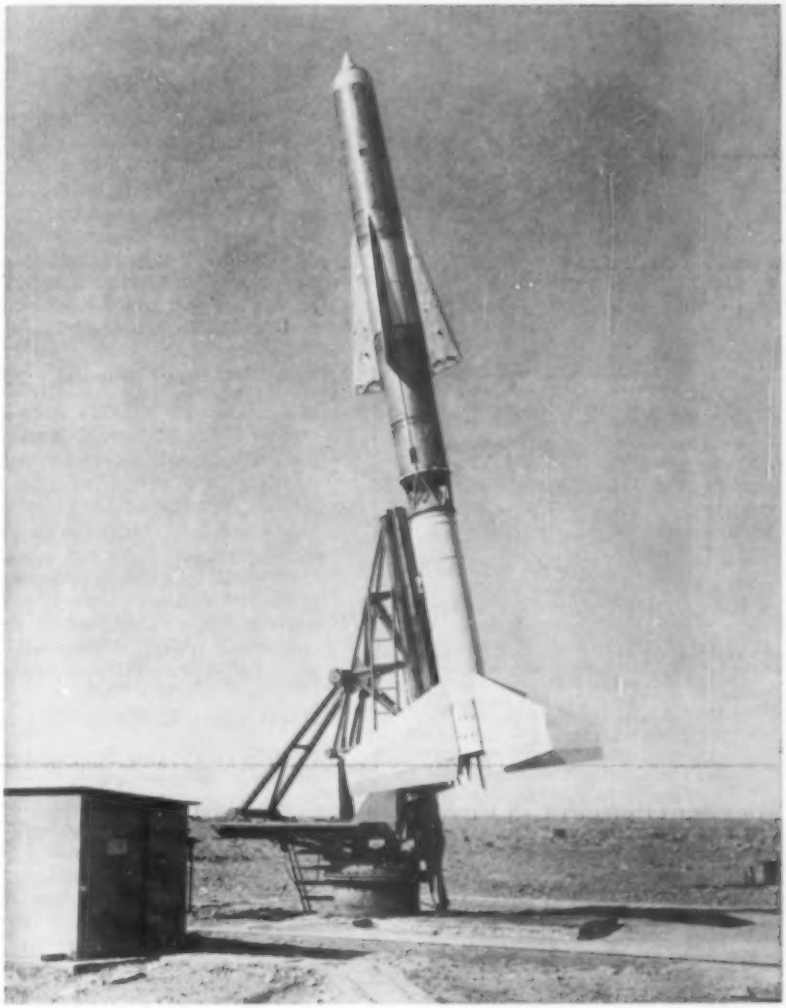
Fuel capacity can be increased to 66 U.S. gallons by utilizing some payload space. Another 3.2 gallons can be added by lengthening in 4-in. increments.

The ramjet has forward control surfaces with very sharply swept cruciform delta wings equipped with roll-stabilizing spoilers. Its design utilizes a double-skinned body with resilient struts to fit the rear of the diffuser to the master frame and its front to the central body, permitting differential expansion.

More than advertised—O.N.E.R.A., French counterpart of NASA, chose to use a photo of the missile on the cover of the brochure it prepared for the Paris Air Show. Before *Vega's* details were released, Maurice Roy, O.N.E.R.A. chief described the "cover missile" as "simply an experimental high-Mach ramjet vehicle with a solid booster."

It has since been learned elsewhere that the Nord *Vega* operates in level flight from "Mach 3 to Mach 5 between 65,000 and 115,000 feet" and uses a "Vesuve"-type propellant grain to reach the ramjet launching speed necessary "between Mach 2 and Mach 3." The ramjet has gone through its paces using kerosene fuels meeting French, British and U.S. specifications.

A prime supporting element on the research missile has been described as a highly-stiffened and double-skinned body supporting the wings or secondary attachment and designed to withstand heat gradients.



NORD AVIATION'S VEGA research missile being checked out at Colomb-Béchar range in Sahara. Note size of man below booster of 32.5-ft. bird. Missile attains Mach 4 speeds in level ramjet-sustained flight.

The refractory alloy combustion chamber terminates in a convergent-divergent nozzle; a frame section at this point links the sustainer to the booster.

A 5-cu.-ft. front payload area is located between the tip of the cone and the lip of the outer diffuser. Two rear compartments, totaling 2.5 cu. ft., are divided in two cone frustums which, in the experimental version, contain the drag chute and a 646-sq.-ft. main chute which slows the spent vehicle to a 30 ft./sec. rate of descent for recovery.

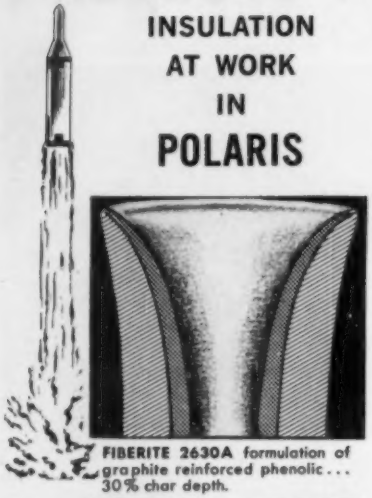
The booster, affectionately nicknamed "Fanny" by the launching crew, uses propellant grain 7.5 to 8.2 ft. long and has a Vascojet 90 steel casing and a steel exit nozzle incorporating a graphite throat section.

The addition of *Vega* to Nord's long line of developments is further advancing the firm's position as one of Europe's most capable missile manufacturers. ⌗

example...

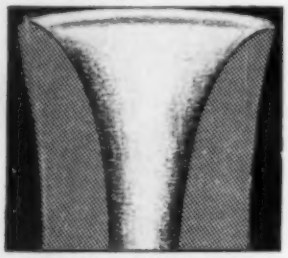
FIBERITE

INSULATION AT WORK IN POLARIS



FIBERITE 2630A formulation of graphite reinforced phenolic... 30% char depth.

Char Depth



Standard graphite reinforced phenolic 100% char depth.

The development of special Fiberite MX 2630A formulations reduce char depth of graphite reinforced phenolic molded insulations up to 70%, thus permitting the use of these materials in more critical solid propellant rocket motors.

Cut-away sections above illustrate reduction of char depth by utilizing Fiberite molding material.

EXPLORE FIBERITE

Missile engineers will find our research helpful in solving problems requiring materials for special performance. Write factory for bulletin "Fiberite High Temperature Insulating Materials."

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THE FIBERITE CORPORATION
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Winona, Minnesota

soviet affairs

By Dr. ALBERT PARRY

Missiles doom aircraft carriers—

proclaims a recent issue of *Krasnaya Zvezda*, the daily organ of the Soviet armed forces, in a lengthy article entitled "Reappraisal of Values," and subtitled "Aircraft Carriers in the Plans of American Strategists." It points out that aircraft carriers (there are none in the Soviet Navy) are on the decline because "rocket-carrying submarines with atomic engines are beginning to play an increasingly large role in the Pentagon's military plans."

Captain V. Lan, author of the article, also states that "American admirals nevertheless believe that the aircraft carrier fleet will yet play a prominent role in the implementation of the Pentagon's aggressive plans." The Soviet writer dismisses this hope as unrealistic: "Although it is as yet incorrect to say that leadership in the American navy has already shifted from aircraft carriers to submarines, the trend is certainly that way." Rocket-carriers are replacing aircraft carriers. Lan concludes.

Knowledge of physics

is a "must" for Russia's new cosmonauts, according to Maj. Gen. George I. Pokrovsky, who doubles as a well-known professor of astrophysics and a high-bracket expert in practical rocketry. He writes in the May 26 *Krasnaya Zvezda*: "The future cosmonaut should, step by step, develop an ability to think scientifically. For this he must master the basic disciplines of physics and mathematics, perhaps even at the university level, but within strictly delimited lines, to avoid his overloading with details of secondary importance. At that, particularly useful is a thorough study of physics—the science, which is the basis and the unifier of all kinds of modern technology, and which permits one to use this technology reliably, under most complex and unexpected conditions, extracting from it a maximum of opportunities."

A jet pilot is the best possible cosmonaut

psychologically, says Yu. Fedotov, a candidate of the medical sciences, writing in the same issue of *Krasnaya Zvezda*. In a detailed discussion of psychological preparation of cosmonauts, Fedotov reports that "the majority of scientists are now in agreement that the first cosmonauts should be flyers with a record of having piloted modern jet planes," because "this in itself is good psychological training and the best means of discovering the psychological qualities needed by outer-space pilots."

He lists these qualities: ". . . an ardent heart, quick mind, steely and balanced nerves, unbending will, stability of spirit, vigor and cheer, lust for life, alertness . . . an ability to orient himself in the complexity of a flight, to react to its changes rapidly, and to make the right decision in a suddenly evolved situation."

Outer space is like a stormy ocean

in the simile suggested by Academician Sergei N. Vernov, a Soviet specialist on radiation belts (a year ago he won a Lenin Prize for his cosmic radiation researches). Quoted in the April issue of *Znaniye–Sila*, Dr. Vernov compares a flight in a rocket to a ship's crossing of an ocean's raging waves. He remarks: "Radiation belts are a kind of 'reefs' in the ocean, while magnetic disturbances caused by flares on the sun are like sea-storms. It will be necessary to chart a spaceship's course with great skill in order to avoid these dangers."

Microminiaturization in Czechoslovakia

was reported in *Krasnaya Zvezda* May 17. Czech scientists, it said, have succeeded in substituting for an electronic oscillator 850 cubic centimeters in size and 200 grams in weight a new instrument of 1.2 cubic centimeters weighing 2 grams. The new device uses 10 times less electric energy than the older, bigger oscillator.

Circle No. 4 on Subscriber Service Card

names in the news

BROWN

DOHERTY

VAN DER WAL

BARANOW

LEESON

Cmdr. Paul H. Backus, USN (ret.): Former head of Ballistic Missile Group on Adm. Burke's staff in the Office of Chief of Naval Operations, joins Sanders Associates, Inc., Nashua, N.H., as corporate coordinator of special assignments.

William C. House: Corporate director of Nuclear Operations, Aerojet-General Corp., Azusa, Calif., named director of Nuclear Engine for Rocket Vehicle Application Operations. NERVA is part of Project *Rover*, a joint AEC-NASA program for the development of a nuclear rocket propulsion system. **Charles H. Trent,** manager, Nuclear Propulsion Division, appointed associate director of the program.

Patricia L. Brown: Information services supervisor, Semiconductor-components Div. of Texas Instruments, Dallas, elected president of the Society of Women Engineers.

Dr. Robert E. Payne: Named director of the Atlantic Missile Range Office of Aerospace Corp., succeeding **Morton Goldman,** who will return to headquarters in El Segundo, Calif., to assume a new program directorship.

Robert F. Garbarini: Promoted to chief engineer of Sperry Gyroscope Co.'s Air Armament Div., Great Neck, N.Y. Garbarini also serves as a technical consultant to the guidance and control panel of the Air Force Scientific Advisory Board.

Capt. John C. Doherty, USN: Named to command the Naval Missile Facility, Point Arguello, Pacific Missile Range, late in July, succeeding **Capt. William J. Scarpino,** who will attend the Industrial College of the Armed Forces, Washington, D.C. Doherty currently is on the staff of the commander-in-chief, Atlantic Fleet.

Arthur B. Billet: Senior staff engineer with Vickers Incorporated, Div. of Sperry Rand Corp., Detroit, elected president of the Institute of Enivronmental Sciences.

Roy Blum: Named general manager of Cryogenics, Inc., Stafford, Va. With the company since its founding, Blum will head up newly-expanded fiscal and administrative operations.

Edgar G. Grant: Former engineering manager, named director of new product planning for the Military Electronics Div., Daystrom Incorporated, Archbald, Pa.

Laurel van der Wal: Head of Bioastronautics, Space Technology Laboratories, Inc., Los Angeles, presented the 1961 Society of Women Engineers Achievement Award. Earlier she was named 1961 Woman Scientist of the Year by the Los Angeles Times and the Aerospace Medical Assn. Wives' Wing. A specialist in engineering problems of manned space flight, Miss van der Wal is best known for originating and implementing Project *MIS*, in which mice rode to space in the nose cones of *Thor-Able* rockets.

Dr. Sanford Baranow: Formerly with the Aircraft Nuclear Propulsion Dept., General Electric Co., Evendale, Ohio, joins the Materials Dept. of Tapco, a division of Thompson Ramo Wooldridge, Inc.

Dr. Bruce A. Reese: Former professor of mechanical engineering and associate director of the Jet Propulsion Center, Purdue University, named deputy chief of the Anti-Missile Missile and Space Defense Projects office of the Army Rocket and Guided Missile Agency.

James L. Anast: Former president of Lear Corp. and director of FAA's Bureau of Research and Development, appointed Chance Vought's Corp.'s manager of European Operations, with headquarters in Paris.

Allan B. Schaffer: Formerly with Space Technology Laboratories and Aerospace Corp., joins Clauser Technology Corp., Torrance, Calif., as a senior scientist in magnetohydrodynamics.

Edward C. Leeson: Named vice president and manager of Kidde Aero-Space Div. of Walter Kidde & Co., Inc., Belleville, N.J. Previously Leeson was vice president of marketing, Kollsman Instrument Corp.

Dr. E. C. Heubschman: Formerly with Convair Astronautics, joins Pan American's Guided Missiles Range Division as space instrumentation specialist in the Technical Laboratory. Other appointments to the Laboratory: **Howard J. Elmore,** instrumentation planning engineer with Technical Systems Planning; **E. W. Hannum,** veteran Pan Am engineer, transferred from the Overseas Div. in New York; **G. A. Wegmann,** formerly with Philco Corp., to work in Data Reduction Systems.

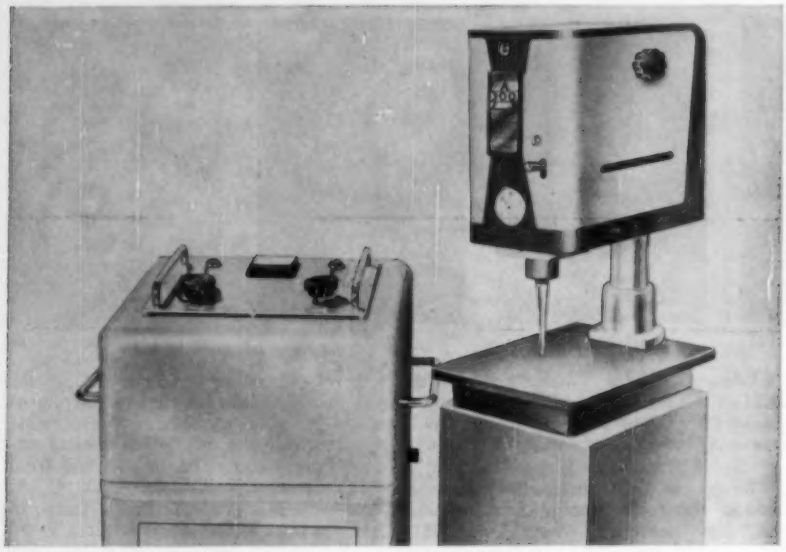
Paul J. Colleran: Former manager of General Electric semiconductor advanced engineering, joins International Rectifier Corp., El Segundo, Calif., as vice president for engineering.

Peter A. Button: Joins Electro-Optical Systems, Inc., Pasadena, Calif., as a senior scientist in Advanced Electronics and Information Systems Div. **Dr. Paul C. Fletcher** has been named principal scientist and manager of the Laser Dept. of the Quantum Physics Div. Prior to joining EOS, Button was a research physicist with Radiation, Inc.; Dr. Fletcher was with Hughes Research Laboratories.

Harold D. Kube: Elected to board of directors of Frederick Research Corp., Wheaton, Md. **Joseph F. O'Marah** joins the headquarters management staff as special assistant to the president in research and development operations. **A. H. Sullivan, Jr.,** named director of Advanced Systems Development.

Charles M. Mooney: Former director of government relations and world-wide integrated systems, elected vice president, U.S. Defense Group, International Telephone and Telegraph Corp., New York City. Mooney succeeds **Adm. Ellery W. Stone,** who will continue as vice president of the parent corporation, and assistant to the president—as well as chairman of the board—of American Cable and Radio Corp.

Louis Kraff, Jr.: Manager of the Space Instrumentation Div. of Technology Instrument Corp., elected to the board of directors of United Systems Corp., Washington, D.C. Formerly Kraff was chief of the Rocket and Instrumentation Branch of the Air Forces' Geophysical Research Directorate.



Ultrasonic Plastic Welder

An industrial tool utilizing ultrasonic energy for the sealing of plastic film and synthetic fabrics has been introduced by Ultra Sonic Seal, Inc. The unit permits the fusion of materials which have resisted or been ineffectively welded by standard processes, even though contaminated with oil and grease. Plastics which can now be instantly and permanently bonded include Mylar polyester, polyethylene, polypropylene, nylon and vinyl films, etc., and synthetic woven fabrics of nylon, and Orlon acrylic and Dacron polyester fibers.

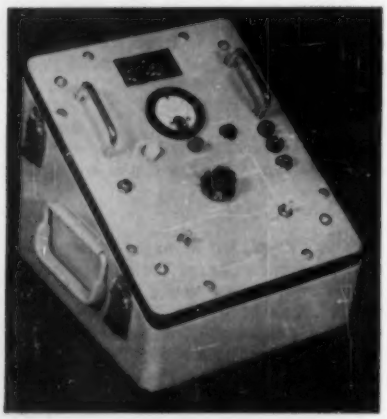
Use of the sealer requires no special training for operating personnel. It does away with set up or down time between jobs; changes in adjustments are easily made. Featuring low-power consumption, it welds silently and quickly without expensive sealing dies. It can cut or seal, and makes butt lap, seam, spot or continuous welds.

Circle No. 225 on Subscriber Service Card

Automatic Cable Tester

A transistorized cable tester which examines each wire individually for leakage and short circuits between conductors resulting from defective insulators, improperly connected wires, cold solder joints or damaged wires is available from Automation Dynamics Corp. Deviations or resistance to 0.1 ohm for continuity and leakage up to 100 megohms are detected. The accepted or rejected wire is identified through clear digital readout. Sequencing on the instrument is either manual or automatic, adjustable to a maximum of one circuit per second.

Circle No. 226 on Subscriber Service Card



Pulse-to-Step Converter

A pulse-to-step converter, Slo-Syn Translator type ST-150, is available from Superior Electric Co. for use in programed positioning, remote positioning, indexing and indicating applications. The device is designed to convert low-level signal pulses or square waves into the correct switching sequence needed to drive a Slo-Syn Synchronous motor at 200 discrete steps per devolution. Speeds may be as high as 225 or 400 steps per second, depending on the motor used. Commands originate from information stored on magnetic or punched tape or from some other type of pulse generator.

Circle No. 227 on Subscriber Service Card

Conical Washer

A line of conical washer Keps® for mounting silicon rectifiers and other stud mounting devices is available from Shakeproof,® Division of Illinois Tool Works. The one-piece Keps combines both washer and nut to simplify handling and mounting. It has been designed to provide take-up spring pressure by utilizing a specially proportioned coned washer. This assures permanent contact between the rectifier and heat sink.

Circle No. 228 on Subscriber Service Card

Converter Amplifier

A single-channel, phase-sensitive, converter amplifier, Model CE-1, is available from Crescent Engineering and Research Co. The portable transistorized instrument is designed for use with potentiometers or a-c variable permeance and differential transformer transducers. It consists essentially of a power supply, oscillator, bridge balance control, gain control, amplifier and demodulator. The unit operates on 115 volt, 60 cycle a-c, provides a carrier

frequency of 1 kc to the transducer bridge and amplifies and demodulates bridge output providing a ±10 volts d-c output full-scale.

Circle No. 229 on Subscriber Service Card

Gimbal Expansion Joints

Gimbal-type expansion joints which absorbe angular rotation in all planes are available from Zallea Brothers. Each gimbal expansion joint is controlled by a structural system consisting of two sets of hinges, oriented at 90°, coupled to a common gimbal ring. This structure restricts the expansion joint to

angular rotation in any plane, absorbs pressure thrust and limits torsional loading on the bellows. It may be designed to carry piping weight, wind loads and other dead weights—thus eliminating guides, supports, anchors and restraints which might otherwise be required.

Circle No. 230 on Subscriber Service Card

Ferrite Core Memory

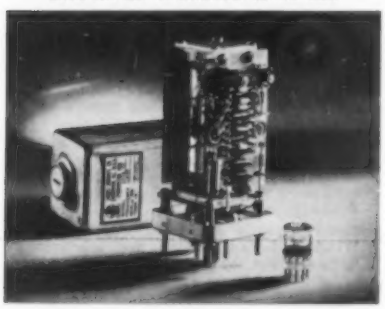
A high-speed, large-capacity memory unit is available from Ampex Computer Products Co. Designated the RQL, this ferrite core memory is available in a wide range of word capacities. Standard word capacity is 1024, 2048, 4096, 8192, 16,384, 32,768. All these word sizes can be obtained in 8-to-60-bit word lengths. Standard operating modes are random access with clear-write, read-generate, load and unload cycles. Also available are split-cycle, short-access and sequential-access. The unit is non-synchronous and all bits of a word are handled in parallel. Memory cycle is 6 microsec., access time 2.5 microsec. and buffer cycle 3 microsec.

Circle No. 231 on Subscriber Service Card

Ultra Stable Frequency

The JKTO-42, an ultra-stable frequency and time base, has been added to James Knights Co. series of compact, plug-in, transistorized oscillators. The JKTO-42 is a one-megacycle unit, employing a special JKG7 crystal designed for this frequency only. The oven is an a-c type proportional control unit that provides precise, automatic temperature control without cycling variations. It holds the temperature of crystal and associated circuitry within 0.005° at a fixed ambient temperature, and 0.01°C, or better, over an ambient temperature range of 0° to 50°C.

Circle No. 232 on Subscriber Service Card



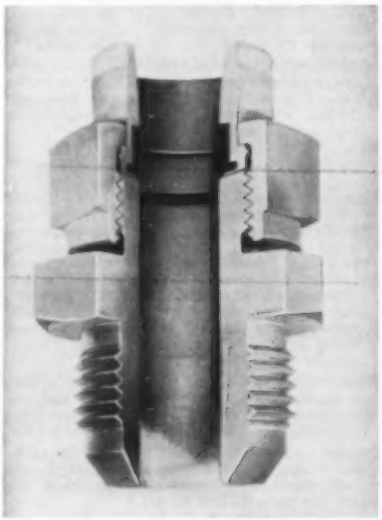
Solenoid Controlled Valve

Direct-operated, three-way, two-position solenoid valve MC-4565-1 is available from M. C. Manufacturing Co. This solenoid valve was developed primarily for use with MIL-H-5606A hydraulic oil at operating pressures up to 3000 psi throughout the temperature range of −65° to 275°F. The solenoid is of the continuous-duty type and conforms to applicable sections of MIL-S-4040C. It is completely sealed to prevent the possibility of damage by atmospheric humidity and foreign gases.

Circle No. 233 on Subscriber Service Card

Rigid Tube Coupling

A high-temperature, high-pressure rigid tube coupling with seal is available from Resistoflex Corp. The Dynatube maintains its seal under conditions of vibration, shock, pressure overloads, pulsing action or temperature variations.



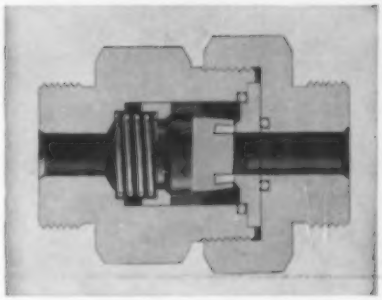
Dynatube provides absolute dynamic sealing for all liquids and gases up to 700°F. It also remains leak-proof under cryogenic conditions.

Circle No. 234 on Subscriber Service Card

Cross-Sectional Shapes

Metal shapes and forms of specified cross-section, especially adapted for development work, prototypes and pilot production are available from the Prontour Co. The Prontour process forms any strip-metal by a vibratory press action, using flat-plate "silhouette" dies which progressively fold the strip to the required cross-sectional form. Close tolerances are maintained and intricate cross-sectional shapes can be made. Shallow flanges, small curls and short legs may be readily formed with precision.

Circle No. 235 on Subscriber Service Card



O-Seal Check Valves

Surge and reverse flow are effectively eliminated in high-pressure liquid or gas systems with a line of silent check valves developed by the Combination Pump Valve Co. Combining a soft, resilient nylon seating principle with the engineered pressure of spring closure, these O-Seal check valves assure positive and leakproof shut-off at pressures to 6000 psi and temperatures from −20 to 275°F.

Circle No. 236 on Subscriber Service Card

Neutron Generator

Development of a low-cost portable generator of fast neutrons by Dresser Industries, Dallas, through its nuclear subsidiary, Well Surveys, Inc., brings to the field of commercially available radiation equipment a fast neutron source operating on 115-volt, alternating current. The unit can be turned on and off at will; when it is not being used it can be stored without safety precautions.

Circle No. 237 on Subscriber Service Card

Magnetic Memory Plastics

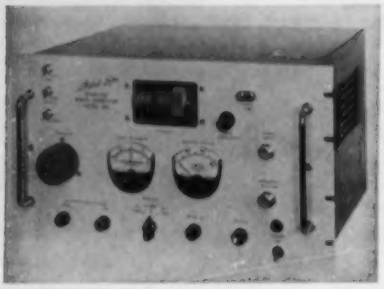
A thermo-setting plastic which can be spot magnetized to provide practically any desired pattern within a molded plastic part is available from Mesa Plastics. The compound, which has been tested beyond 400°F, includes non-conductive ferrite powder fillers capable of retaining either temporary or permanent magnetic charge. Polarity of the magnetic field set up may be oriented in any chosen direction.

Circle No. 238 on Subscriber Service Card

Packaged Power

A type of power package, consisting of a motor and high-ratio transmission completely sealed inside a stainless steel container, has been developed by United Shoe Machinery Corp. to overcome the effects of outer space on many of the actuating elements of missiles and space vehicles. These drives, which can be designed to meet the specific operating requirements for various space applications, are based on the Harmonic Drive principle of transmission.

Circle No. 239 on Subscriber Service Card



Microwave Generator

An "S" Band (3 kmc) stabilized signal generator providing full-octave bandwidth is available from Strand Labs, Inc. The instrument's design incorporates a unique patented Microwave Discriminator and high-gain d-c feedback amplifier providing automatic frequency control of the klystron oscillator to 0.01 parts per million, and frequency setability accuracy of 0.05%.

Circle No. 240 on Subscriber Service Card

Level Control Instruments

A line of level control instruments, including electric and pneumatic transmitters that also provide indication and can perform alarm and "on-off" control functions, is available from the Brooks Instrument Co., Inc. The instruments, utilizing a magnetic position converter, can be supplied in special materials for toxic, corrosive, and high-pressure (to 40,000 psi) services. They are available with buoyant and displacer floats for liquid or interface level or specific-gravity applications.

Circle No. 241 on Subscriber Service Card

Piezoid Ceramic

A piezoid ceramic material designated as Tyzamic-14 is available from Centralab. The material is available in an almost unlimited variety of shapes—discs, cylinders, tubes, plates and blocks can be supplied, as well as unsymmetrical shapes. The material has an extremely stable dielectric constant from 55° to 300°C. Transducer elements can be supplied with electrodes covering the entire surface of the element or limited to any designated area.

Circle No. 242 on Subscriber Service Card

Titanium Alloy Powder

One of the highest-strength materials that can be made by powder metallurgy processing is available from the Mechanical Research Division of Clevite Corp. Designated as CPT-64AV, this sintered titanium alloy has an excellent balance between tensile strength (119,000 psi). ductility (6% elongation), and hardness (Rockwell C 23). Strengths as high as 146,000 psi can be obtained by heat treatment.

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contracts

NASA

$660,000—**Vought Astronautics Div., Chance Vought Corp.**, Dallas, for production of six 105-in. diameter liquid oxygen tanks for *Saturn* space booster.

$379,000—**Radiation, Inc.**, Melbourne, Fla., from **Cornell Aeronautical Laboratory**, for microwave satellite transmitters.

$318,303—**Electro-Optical Systems, Inc.**, Pasadena, Calif., for development of a solar-energy thermionic conversion system.

$100,000—**Clauser Technology Corp.**, Torrance, Calif., for feasibility studies of a magnetic induction plasma engine for space vehicles.

DEPT. OF DEFENSE

$5,400,000—**Radio Corp. of America**, Moorestown, N.J., for engineering, fabrication, and checkout of the TRADEX radar being built as part of Project PRESS (Pacific Range Electromagnetic Signature Studies).

MISCELLANEOUS

$230,000—**United Technology Corp.**, Sunnyvale, Calif., from **Edwards AFB**, for research and development of an advanced high-performance solid propellant; from **Office of Naval Research**, for research work in the thermochemistry of the high-energy fluorine bond. (Two contracts.)

$228,000—**Electro Instruments, Inc.**, San Diego, from **Raytheon Co.**, for two advanced systems for high-speed in-plant testing of complex missile components and equipment.

NAVY

$16,400,000—**Sperry Rand Corp.**, New York City, as follows: **Sperry Gyroscope Co.**, $7,500,000 for modification and improvement of *Talos* missile guidance radars; $4,800,000 for continued production of new passive underwater detection system for submarines; $1,400,000 for radar engineering and technical services; **Sperry Piedmont Co.**, $2,700,000 for increased reliability and performance of original *Terrier* missile guidance radars.

$1,000,000—**Cryo-Therm, Inc.**, Fogelsville, Pa., from **Lockheed Missile & Space Co.**, for temperature stabilization systems for shipping *Polaris* missile guidance capsules.

$750,000—**Aircraft Armaments, Inc.**, Cockeysville, Md., from **BuWeps**, for design and manufacture of guidance monitors for *Terrier* fire control radars.

$340,000—**Zero Mfg. Co.**, Burbank, Calif., for containers for storage and shipment of electronic instruments and parts for *Polaris* missile system.

$150,000—**Daystrom, Inc., Pacific Div.**, Los Angeles, for control gyroscopes for Mark 44 torpedo.

$100,000—**Space Electronics Corp.**, Glendale, Calif., from **Naval Ordnance Test Station**, for dual-channel phase-lock receivers for tracking and telemetry in the *Transit* program.

Military Electronics Div. of Daystrom, Inc., Archbald, Pa., from **BuWeps**, for production of warhead adaption kits and repair parts for the *Terrier* missile. No amount disclosed.

ARMY

$6,273,972—**Western Electric Co.**, Burlington, N.C., for continuation of work on *Nike-Hercules* air-defense guided missile system.

$4,000,000—**Texas Div. of Collins Radio Co.**, Dallas, for portable scatter communication terminals (AN/TRC-80).

$3,957,124—**Northrop Corp.**, Beverly Hills, Calif., for production of launchers for *Hawk* air defense system; $2,999,986 for production of warhead components for *Sergeant* missile; $2,571,529 for flight service for the *RP-76* target missile.

$2,917,800—**Bendix Corp.**, Ann Arbor, Mich., for ground-based electronic equipment for Project *Advent* shipboard terminal.

$2,588,133—**Aircraft Armaments, Inc.**, Cockeysville, Md., for production of training devices for the *Sergeant* missile system.

$1,355,000—**Alco Products, Inc.**, Schenectady, N.Y., for 7 diesel-electric generating units to produce "precise power" for Advanced Research Projects Agency's Pacific missile facility.

$609,000—**Bendix Corp.**, Detroit, for missile re-entry research being conducted at the Canadian Armament R&D Establishment.

$525,000—**Western Electric Co.**, New York City, for repair parts for support of *Nike-Hercules* fault-locating indicators.

$497,000—**Talley Industries**, Mesa, Ariz., for research, development, testing and production of 52 actuators for *Titan II* underground silo doors.

$438,000—**Babcock Electronics Corp.**, Costa Mesa, Calif., from **The Martin Co.**, for airborne range safety receivers and support equipment for *Lacrosse*.

$294,395—**Twin Coach Co.**, Buffalo, N.Y., from **Raytheon Co.**, for electronic consoles for the *Hawk* missile system.

$175,380—**U.S. Gauge Div. of American Machine & Metals, Inc.**, Philadelphia, for precision switches for warheads of tactical missiles.

$130,780—**Raytheon Co.**, Waltham, Mass., for concurrent repair parts for the *Hawk* missile system.

General Precision, Inc., Palo Alto Western Development Laboratory, from White Sands Missile Range, for design and construction of 8 ballistic camera synchronization units. No amount disclosed.

AIR FORCE

$11,158,000—**North American Aviation**, Los Angeles, for *GAM-77A* air-to-surface missiles.

$9,000,000—**General Electric Co.**, Evendale, Ohio, from **Thiokol Chemical Corp.**, for development and manufacture of *Minuteman* first-stage solid-fuel rocket cases.

$2,500,000—**General Dynamics/Astronautics**, San Diego, Calif., for three *Atlas* missile procedure trainers.

$750,000—**C&D Batteries Div. of Electric Autolite**, Conshohocken, Pa., for batteries to provide emergency power supplies to *Minuteman* ICBM weapon system.

$500,000—**Epsey Mfg. & Electronics Corp.**, New York City, from **The Martin Co.**, for battery-charger power supply units for the *Titan II* ICBM program.

$500,000—**Menasco Mfg. Co.**, Los Angeles, from **General Dynamics/Astronautics**, for titanium-alloy pressure vessels for *Atlas* ICBM and *Centaur* programs.

$492,000—**Thiokol Chemical Corp.**, Elkton, Md., for continued research on high-energy solid propellants.

$350,000—**Motorola, Inc.**, Scottsdale, Ariz., for development and production of high-power C-band pulse transponders for Patrick AFB Missile Test Center.

$346,000—**Atlantic Research Corp.**, Alexandria, Va., for development of new family of solid propellants having higher energy and performance characteristics.

$268,000—**Texas Instruments, Inc.**, Dallas, for design and development of unattended marine seismic monitoring system.

$124,000—**Hughes Aircraft Co.**, Culver City, Calif., from **Aeronautical Systems Div.**, for development of new plastic materials and self-cooling techniques for missile exhaust nozzles for operation in extreme temperatures.

United Aircraft's Hamilton Standard Div., Windsor Locks, Conn., for electrically-driven hoists for work cages in the underground launch sites of *Minuteman*. No amount disclosed.

—when and where—

JULY

Planning Aspects of Atomic Shelter, seminar, Pennsylvania State University, University Park, July 9-21.

Western Plant Maintenance and Engineering Show, Pan Pacific Auditorium, Los Angeles, July 18-20.

Structural Engineering Aspects of Atomic Shelter, seminar, Pennsylvania State University, State Park, July 23-Aug. 4.

AFOSR, Differential Equations in Nonlinear mechanics, cosponsored with Martin's RIAS, Air Force Academy, Colorado Springs, Colo., July 31-Aug. 4.

Physics of the Solar System and Re-entry Dynamics, National Science Foundation, NASA, Virginia Polytechnic Institute, Blacksburg, Va., July 31-Aug. 11.

AUGUST

Space Age Astronomy, sponsored by Douglas Aircraft Co., CalTech, Pasadena, Aug. 7-9.

American Rocket Society/Stanford University, Guidance and Control Conference, Stanford University, Palo Alto, Calif. (some sessions classified), Aug. 7-9.

Sixth Annual Technical Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles, Aug. 7-11.

Survival in the Nuclear Age—Executive Management, seminar, Pennsylvania State University, Aug. 13-18.

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letters

(Continued form page 4)

On Space 'Conservatism'

To the Editor:

It was appropriate, if accidental, that you should position "New Route to Cathay —Step by Step" (M/R, May 29, p. 37) immediately after "Science Takes Dim View of Man in Space." As if to add interesting emphasis to the not-so-subtle implication, you end a three-article sequence with "Booster Ideas Are Big and Varied" (could have been called "NASA Ideas Are Stunted and One-Tracked").

The first article describes a few "men" of science who, far from being dedicated to exploring new frontiers, are seeking to hide their fear of the unknown behind pseudo-scientific rationalization. Then along comes Mr. (Ralph) Cooper and sums up, in a delightful parody, the saga of what today might be termed "The Yellow American" or "The Role of Conservatism in Outer Space." In the third article we read of an exciting challenge flung by American enterprise at slothful NASA. Proven technology puts forth, in the true spirit of Columbus, concrete plans and real hardware with which the new Road to Cathay may be explored, only to be accused of over-zealous and exaggerated claims.

The situation was pregnantly packaged by Astronaut Shepard who, when asked by President Kennedy "What do you want to do next?", answered "Just let us go. We are being protected too much with equipment . . . (we want) to be free to explore space with less protection and more initiative and daring."

We should all rejoice that of such stuff astronauts are made. We should likewise mourn the fact that there are chicken-hearted Americans with tremendous "purse power" who very nearly cut Astronaut Shepard's booster out from under him.

Walter H. Trask
Lockheed Missiles & Space Div.
Sunnyvale, Calif.

Acronymizing

To the Editor:

I have a couple of suggestions for the Air Force regarding their quandary over the name *Saint* (M/R, June 12, p. 9).

First, for their critics they could substitute the code name *ASININE*, standing for Antisatellite Satellite INspection and INtercept Equipment.

Then, to provide the antithesis of the original name, they could go to *SINNER*, representing Satellite INspection and Navigated Equipment Recovery (although this is not quite correct technically).

Maj. Q. C. LaPrad
Ft. Bliss, Tex.

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editorial . . .

Thoughts on Non-Profit Firms

FOR SOME TIME, the U.S. military has been leaning more and more heavily on non-profit corporations for technical management and scientific evaluation. The House Appropriations Committee now has taken a roundhouse swing at those non-profit corporations in general and at Aerospace Corp. in particular.

In reporting out the Defense appropriation bill, the committee uses strong words to denounce contracts with non-profit organizations as a subterfuge to avoid the restrictions of civil service salary scales.

The committee demands that the Secretary of Defense come up with a realistic policy on the subject before presenting the next annual Defense estimates.

The Congressmen draw a specific bead on the newest of the non-profit groups, Aerospace Corp. They charge that the salaries paid by Aerospace are excessive, that its overhead costs are too high and that it plans to employ too large a staff.

The committee adds emphasis to its words by whacking a hefty $5 million off the budget request of $35,200,000 for Aerospace for Fiscal 1962.

"The Air Force should either be able to obtain its required services from Aerospace Corp. for $30,200,000 or find another method of coping with the problems involved," the committee asserts.

It is not our intent here to defend Aerospace Corp. from the committee's specific charges. But we would like to suggest that a more realistic appraisal would put the position of Aerospace and the other non-profit corporations in better perspective.

To denounce use of these corporations as a "subterfuge" for avoiding civil service salary restrictions is so much political hogwash. It is no subterfuge at all. It is quite frankly and openly one of the basic reasons why the corporations exist.

Management of today's weapon systems, evaluation of competitive technical proposals, requires talent of a level which cannot ordinarily be hired at military or civil service pay scales. To hire men technically competent to do the job requires salaries competitive with private industry. The non-profit corporations provide these.

For many years, industry was faced with a situation where the men evaluating competitive technical bids were far less competent than the engineers drawing up the proposals. Some bad decisions resulted. Use of the non-profit corporations has been, in part, an effort to remedy the situation—even if not a perfect answer.

There seems to be a general feeling in uninformed quarters that since the non-profit corporations do not have to pay dividends to stockholders, their earnings are distributed as largesse to officers and employes or in the form of magnificent expense accounts. This is not the case.

System Development Corp. for one, conducts frequent surveys of current salary scales in private industry to make sure its salaries are not out of line. Ask its president, Melvin Kappler, whether he could make more money elsewhere in salary and fringe benefits such as stock options. Ask the president of Aerospace, Ivan Getting, the same question.

IN 1959, a committee of outside scientists and industrialists was appointed by the Secretary of the Air Force to study the management needs of that service. Dr. Clark B. Millikan of California Institute of Technology headed the group. Its primary task was to study the relationship between the Ballistic Missile Division and Space Technology Laboratories. While finding that the time had come to modify the arrangement in relationship to STL, the Millikan committee acknowledged that the Air Force had to have, in some form, access to the kind of high competence supplied by STL.

Aerospace Corp. was the answer.

"Essentially, this corporation will be people—people of the highest quality," the Secretary of the Air Force said at that time.

It takes competitive salaries to attract people of that quality from private industry. The sooner the Appropriations Committee acknowledges the fact, the sooner it will come to a realistic appraisal of the problem.

There are areas in which Aerospace and the other non-profit corporations should be watched closely. They have a tendency to over-expand. In certain fields, they compete with private industry.

The Millikan committee asserted that detailed development-systems engineering and detailed technical direction of specific missile/space projects should be the responsibility of normal competitive industry. Congress should make sure this recommendation is followed.

But sweeping condemnations of the non-profit institutions, such as the House Appropriations Committee has just made public, do a disservice to the nation.

William J. Coughlin

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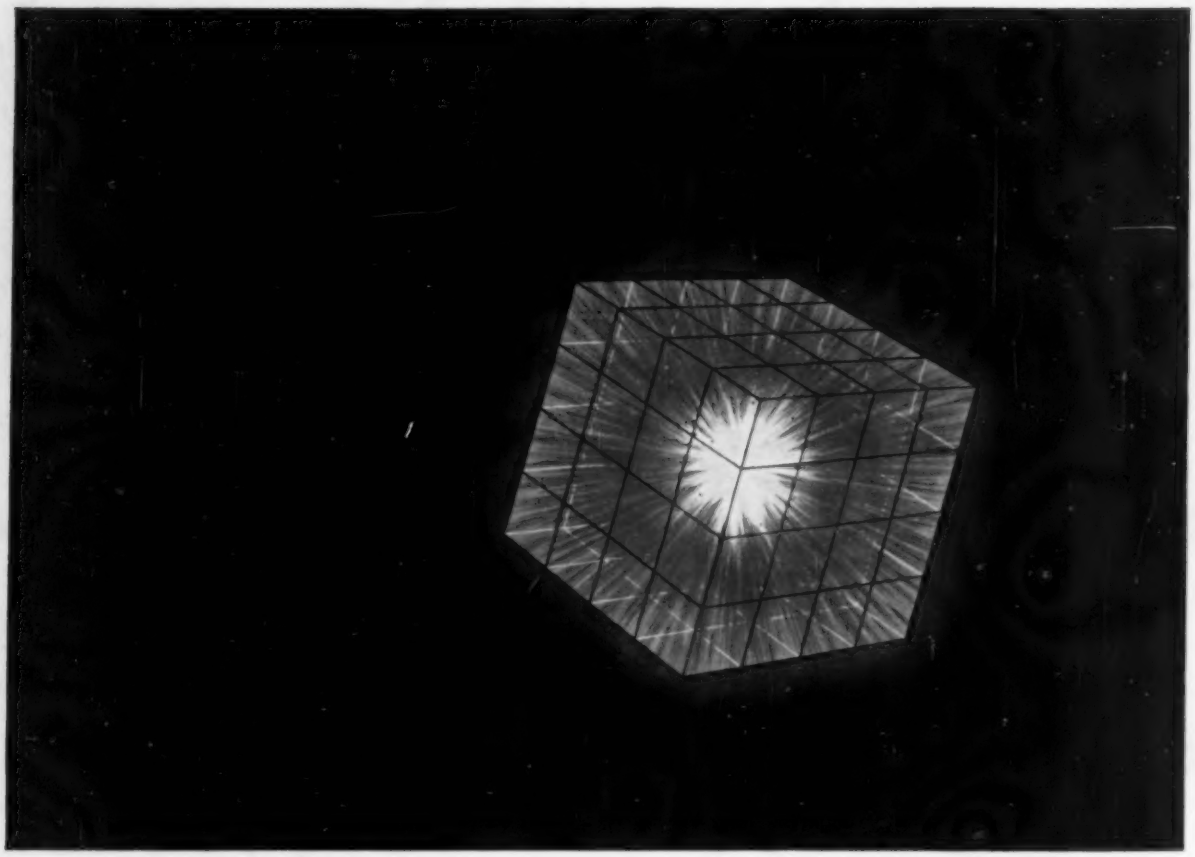

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